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Evaluation of an Interactive Multimedia Program on Calcium and Folate Composition of Foods

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Evaluation of an Interactive Multimedia Program on Calcium and Folate Composition of Foods

by

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Dedication

To my family:

To my husband Doug and children Douglas and Lisa
for their support and acceptance of the pursuit of this doctorate

And
To my parents
for providing a home that nurtured self-confidence,
self-efficacy, and security for every endeavor

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Evaluation of an Interactive Multimedia Program on Calcium and Folate Composition of Food

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An interactive multimedia (IMM) program on calcium and folate composition of foods was developed and evaluated as an adjunct to traditional nutrition curricula. Subjects were 600 students enrolled in introductory and advanced nutrition courses at 7 universities in the United States. Changes in cognitive performance were assessed with multiple choice questions; attitude and self-efficacy were measured by 5-choice Likert-type rating scale items. One-day food records were collected pre- and post-intervention from introductory students. Student t-tests were used to compare change scores between groups. Pearson correlation coefficients identified relationships between variables.

Average cognitive gains of 11%±17% (mean ± standard deviation) for introductory and 13%±12% for advanced experimental (IMM) groups differed from gains of 6%±15% and 3%±9% for comparable controls, respectively

($p \leq .001$); however, mean posttest scores of 45%±18% for introductory and 52%±12% for advanced IMM students were below the 70% typically needed for passing grades. Self-efficacy gains of 21%±15% for introductory and 5%±11% for advanced experimental students were greater than gains of 11%±14% and 0.3%±12% for respective controls ($p \leq .007$). Changes in attitude of 4%±7% versus 3±7% for introductory IMM subjects and controls, respectively ($p = .007$) were small; changes in attitude among advanced groups did not differ. Behaviorally, nutrient density as measured by intake/1000 kcal indicated a mean gain of 51 mg calcium for IMM students versus a decrease of 29 mg among controls ($p = .019$). For folate, the mean gain of 46 μg for the IMM group compared to the increase of 12 μg for controls did not reach significance ($p = .057$). Instructional method was correlated with changes in cognition, attitude, self-efficacy, and calcium/1000 kcal for introductory students, but only with changes in cognition and self-efficacy for advanced students ($p \leq .05$).

Stronger motivational techniques may have promoted better cognitive performance. However, acquisition of knowledge and promotion of self-efficacy regarding application of food composition knowledge were enhanced with IMM intervention. Food selection behavior as indicated by consumption of calcium/1000 kcal improved with IMM use. Incorporation of the IMM program into traditional nutrition curricula may enhance both educational and food behavioral outcomes.

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Chapter 1: Introduction

The ultimate goal of nutrition education is to improve health of individuals or groups by promoting better eating habits. Effective nutrition education provides meaningful and useable information to the target audience. In addition, nutrition education increases an individual's sense of self-efficacy and facilitates the change process by motivating the learner to change attitudes and alter behaviors.

To promote wise food choices, nutrition educators utilize 3 types of information: general, food-based, and nutrient-based guidance. The *Dietary Guidelines for Americans 2000* (1) and general descriptive objectives such as *Healthy People 2010* (2) set forth broad goals linking nutrition and health. *Healthy People 2010* outlines 28 focus areas, 14 of which encompass nutrition objectives. The most common form of food-based guidance developed and promulgated by the United States Department of Agriculture (USDA) is a visual tool, the *Food Guide Pyramid* (3) which depicts the number of servings from 6 food groups that meet the range of nutrient needs of most consumers. Nutrient-based guidance from the National Academy of Sciences sets forth the current Dietary Reference Intakes (DRIs) (4,5), designated as Recommended Dietary Allowances (RDAs) or Adequate Intakes (AIs), that meet nutritional needs for reference groups of healthy individuals. Although nutrition information is widely disseminated by government, industry, and health organizations, many Americans report poor food choices and inadequate nutrient intake as documented by the National Health and Nutrition Examination Survey III (NHANESIII) (6), USDA's Continuing Survey of Food Intakes by Individuals and Diet and Health Knowledge Survey (CSFII/DHKS) (7), and National Health Interview Surveys (NHIS) (8).

Models of behavior change, such as the health behavior model (9), the stages of change model (10), and the social-cognitive theory model (11), map the processes involved in behavior change. No single model is superior; interrelated constructs from multiple models best predict the likelihood of change (11-14). Self-efficacy, the belief a person has in his/her ability to implement a behavior or task, is a common element in various models of behavior change (11).

Interactive multimedia (IMM) approaches in nutrition education may enhance both knowledge acquisition and the planned change process. Consumers today are increasingly computer literate and many expect multimedia-type entertainment to be a part of educational material. The first of the health communication goals of *Healthy People 2010* (2) is to increase household access to the Internet. Successful IMM programs enhance knowledge acquisition, skill development and improve self-efficacy through tutorials, problem solving and simulations (15-17); these programs have been used in academic settings and can be made available to the public on the Internet.

The purpose of this investigation was to develop an IMM program on the nutrient composition of food, and to test its effect on knowledge, attitude, self-efficacy and food behavior. The review of literature presents current information on: nutrition education tools; calcium and folate intake and food selection behaviors; the theories of the change process and application to nutrition education; interrelationships of knowledge, attitude, and self-efficacy; and IMM approaches to health and nutrition education. Subsequent chapters describe the development and testing of an IMM program targeted to college students that present food sources for calcium and folate is described. Changes in cognition, attitude, self-efficacy, and nutrient consumption are assessed and compared for college students enrolled in IMM enhanced and traditional introductory and advanced nutrition classes. The results are presented and contrasted with the literature reviewed.

A USDA Higher Education Challenge Grant #96-38411-02827 with matching funds provided by the University of Texas at Austin partially funded this study. Preliminary data have been reported in several abstracts published in the *Journal of the American Dietetic Association* (18,19).

Chapter 2: Review of Literature

This chapter reviews current literature on nutrition guidance tools, recommended levels and surveys of nutrient intake and consumption of food group sources of calcium and folate by young adults. Also reviewed are models of the change processes for health behavior, including interrelationships between knowledge, attitude, self-efficacy, and interactive multimedia (IMM) approaches to nutrition and education in a variety of disciplines.

TOOLS FOR NUTRITION GUIDANCE

Nutrition educators use 3 types of information to guide consumers: general, food-based, and nutrient-based recommendations. The *Dietary Guidelines for Americans 2000* (1) and *Healthy People 2010* (2) are examples of general nutrition guidance; the *Food Guide Pyramid* (3) is a consumer-friendly model of a daily food plan; and the Dietary Reference Intakes (DRIs) (4,5) are amounts of nutrients that are recommended to meet needs of most healthy individuals. Together, these 3 types of nutrition information provide a continuum of guidance for making food choices to promote good health.

Dietary Guidelines for Americans 2000 (1,20), recently revised by the United States Department of Agriculture (USDA) and United States Department of Health and Human Services (USDHHS), includes 3 major areas: fitness, diet to promote health, and sensible lifestyle choices. The *Dietary Guidelines* were used in the development of several objectives in *Healthy People 2010* and emphasize a diet based on the *Food Guide Pyramid*.

Developed and published by the USDHHS, *Healthy People 2010* (2) outlines 28 public health focus areas; 14 of the focus areas recognize links between diet, health, and disease. Four objectives within the focus areas are relevant to this dissertation. Within the Education and Community-based Programs Focus Area, an objective is to increase information about dietary habits and disease targeted to college and university students, the research subjects for this dissertation. Another objective in this focus area is the provision of education and screening in community and worksite health promotion programs. Within the Health Communication Focus Area, the objective to improve Internet health information sources is pertinent to this dissertation because IMM is easily adaptable to the Internet. Increasing calcium intake is an objective within the Nutrition and Overweight Focus Area, and increasing consumption of folic acid is an objective within the Maternal and Child Health Focus Area.

In 1992, the USDA developed the *Food Guide Pyramid* (3,21,22), a versatile, visual tool for consumers that presents the number and sizes of servings from each of 6 food groups that should result in good nutrition. General recommendations for number of servings range from 6 to 11 servings for the grains and cereals group at the base of the pyramid, to moderation for fats, sweets, and alcohol from the apex of the pyramid. Fruits, vegetables, milk and dairy products, and meat and meat substitutes comprise the remaining 4 food groups in the pyramid. Serving number recommendations for 3 kilocalorie (kcal) levels of 1600, 2200, and 2800 kcal also are specified. Variations of the *Food Guide Pyramid* have been developed for vegetarians and for children.

The most recent nutrient intake recommendations are the DRIs, published from 1997 to 2001 by the Food and Nutrition Board of the Institute of Medicine of the National Academy of Science (4,5). The DRIs are stated as Recommended Dietary Allowances (RDAs) or Adequate Intakes (AIs) that specify amounts of various nutrients that should promote health in people in various sex and age categories. The current DRI for calcium for young adults is 1000 mg calcium per day with no increase during pregnancy or lactation. The current DRI for folate for young adults is 400 μg per day. For women of childbearing age, it is recommended that the 400 μg per day be from supplements or enriched foods in addition to the amount of folate in a varied diet. The recommendation for folate from supplements or enriched foods increases to 600 μg during pregnancy and 500 μg during lactation.

SURVEYS OF DIETARY INTAKE AND PYRAMID FOOD GROUP KNOWLEDGE

This section reviews intake data for young adults, 20-39 years of age, from the National Health and Nutrition Examination Survey III (NHANESIII) (6), the USDA's Continuing Survey of Food Intakes by Individuals and Diet and Health Knowledge Survey (CSFII/DHKS) (7), the National Health Interview Surveys

(NHIS) (8), and other smaller studies (23-26). Calcium, folate and food pyramid group serving data were obtained from diet recall, food frequency questionnaires, and/or food records. CSFII/DHKS (7) also surveyed knowledge of pyramid recommendations.

As shown in Table 1, mean calcium intakes for males, 796-1204 mg/day, met at least 80% of the DRI of 1000 mg/day. Mean intakes for females, 673-820 mg/day, met 80% of the DRI for only 1 of the 5 studies reviewed. Calcium from mineral supplements is not included (6,7,23,24); however, 33-50% of males and females interviewed for the CSFI reported that they took a vitamin and/or mineral supplement (7). For all surveys reviewed, folate consumption from food averaged 314-341 μg/day for males and 156-288 μg/day for females. Males again met approximately 80% of the DRI of 400 μg/day, but females consumed only 40%-72% of the DRI. When Firth, et al recalculated intake data for females to reflect 1998 enrichment standards (27), the average folate intake increased to 551 μg/day (25). Adjustment for folate enrichment and supplements increased the mean intake for females to 609-718 μg/day (25,26). Although these adjusted mean intakes of folate exceeded the DRI, individual consumption ranged from 262 to almost 3000 μg/day (26); about 50% of females did not meet the DRI and less than ⅓ of females consumed the currently recommended 400 μg/day synthetic folic acid from fortified food or supplements (26).

Table 1 Mean consumption of calcium and folate among young adults

Study Data collection	Group	n	Calcium, mg[a]	Folate, µg[b] D	D+F	D+F+S
			← Mean ± standard deviation →			
DRI			1000	400[c]		
NHANESIII (6) 24-hr recall	M[d] 20-39 F 20-39	1579 1629	1063±1403[e] 766±888	341±501 233±339		
CSFII (7) 24-hr recall	M 20-39 F 20-39	1670 1536	969 680	314 226		
Norris et al (8) 2x FFQ[f]	M>18 yr F >18 yr	4627 6200	796[g] 673[g]	322[g] 241[g]		
Koszewski and Kuo, (23) FFQ	College Females	131	820±489			
Hoffman (24) 3 day record	M 18-35 F 18-35 M 18-35 F 18-35	70 135 34 68	1204±671 785±435	 315±182 156±149		
Firth et al (25) 14 24 hr records	F 18-45	21		288±195	551±279	609±327
Lewis et al (26)						
NHANESIII	F 20-49	2231				718
CSFII	F 20-49	2438				644

[a] Supplements not included
[b] Folate from diet (D), diet at current fortification levels (D+F), and diet plus fortification and supplements (D+F+S)
[c] DRI recommendation for women of childbearing age: 400 µg/day folic acid from supplement or fortified foods in addition to dietary folate
[d] M=Males and F=Females
[e] Computed from NHANES data for 20-29 and 30-39 age groups
[f] FFQ=food frequency questionnnaire
[g] Computed from NHIS data for three ethnic groups

Figure 1 illustrates the consumption of pyramid food group servings/day compiled from the DHKS subset group of CFSII/DHKS (7); interviewers obtained 1-day dietary recalls from these subjects on 2 non-consecutive days. For purposes of analysis and comparison, the recommended servings for a 2800 kilocalorie (kcal) intake are used for males, and recommended servings for a 2200 kcal intake are used for females. On the average, males and females consumed 60% and 40%, respectively, of the 3 milk servings suggested for adults less than 25 years. Males met at least 80% of recommendations for grains, vegetables, and meat, while females met at least 80% of recommendations for vegetables and meat. Both males and females reported intakes of less than half of fruit serving recommendations, and females met only ⅔ of grain recommendations. Mean food group intakes of those correctly identifying the recommended number of servings for kcal intake level, as compared to those who did not identify the correct number of servings, were increased at least 10% for males for grains (28% increase), fruit (14%), and meat (14%), and for females for grains (10%) only. Even though intakes were increased, males who knew the recommended amounts still consumed less than ⅔ of recommended servings for fruit and milk. Similarly, their females counterparts consumed less than ¾ of grain serving recommendations, and less than half the number of fruit and milk recommendations. Thus, there is a disparity between available nutrition guidance, nutrition knowledge, and actual intake; understanding why this chasm exists

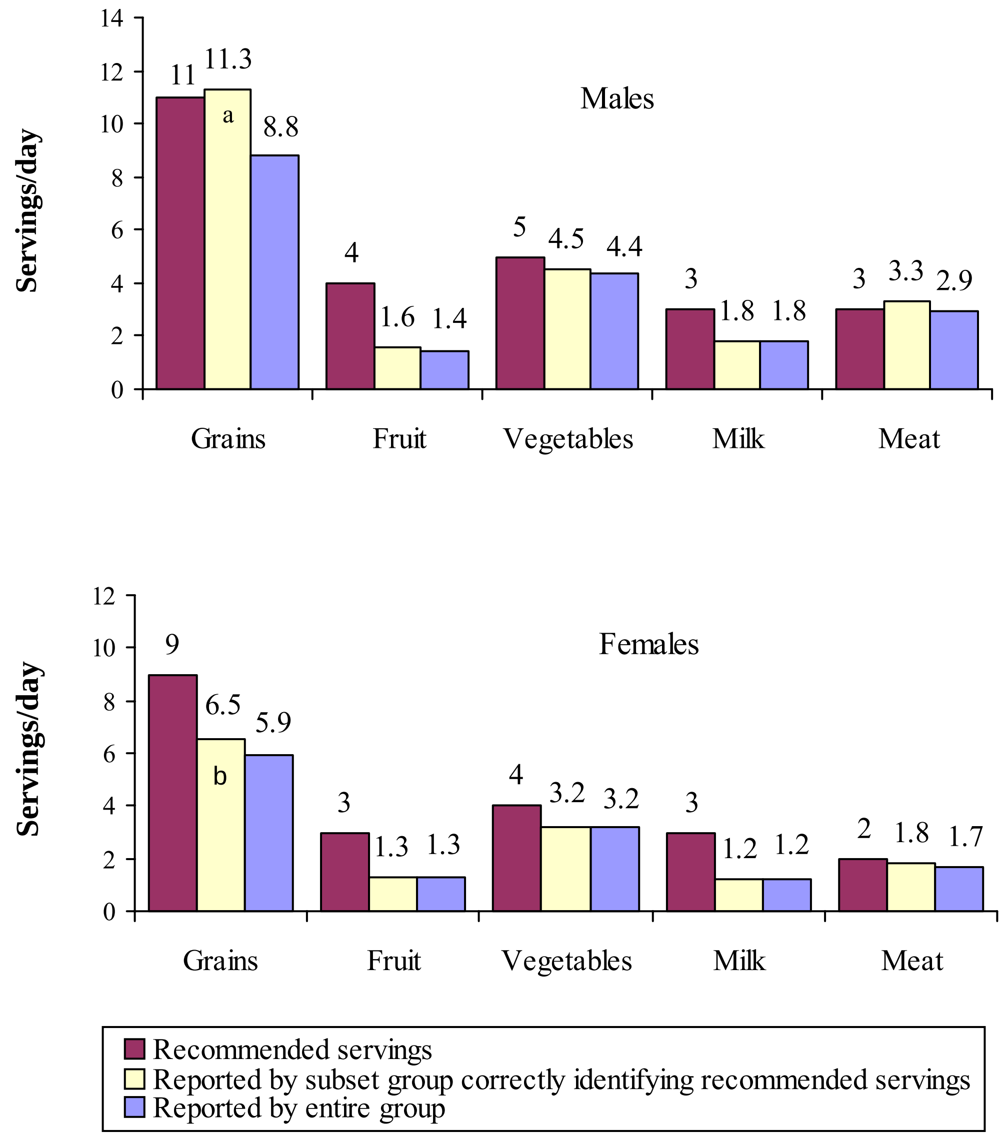

Figure 1 Average servings from the Food Guide Pyramid for adults 20-39 years as reported from the Diet and Health Knowledge Survey (CSFII/DHKS) (7)

[a] *Number (percent of 848) males correctly identifying recommended servings: grains n=42 (5%), fruit n=212 (25%), vegetables n=85 (10%), milk n=195 (23%), meat n=823 (97%)*

[b] *Number (percent of 826) females correctly identifying recommended servings: grains n=107 (13%), fruit n=190 (23%), vegetables n=124 (15%), milk n=256 (31%), meat n=702 (85%)*

would enable nutrition educators to develop approaches to enhance planned change in food behaviors of college-aged adults.

Young adults list major sources of nutrition information as media and friends and family (28-30), rather than reliable sources such as classes or nutritionists/dietitians. Therefore, young adults may have either inadequate or inaccurate information, or they do not have the attitude, skills, self-efficacy, or motivation to select foods to meet dietary recommendations. The challenge to nutrition educators is to provide useful information and skills to enhance self-efficacy and motivate individuals to change food selection behaviors to reduce the divergence between recommendations and reported intakes of calcium, folate, and food group servings.

INTERRELATIONS OF NUTRITION KNOWLEDGE, ATTITUDES, SELF-EFFICACY AND FOOD CHOICES

This section describes the impact of nutrition knowledge, attitude or beliefs, and self-efficacy on food behaviors. The roles of knowledge, attitudes, and self-efficacy components are explored in 3 behavior models: the health belief model, the stages of change model, and social cognitive theory (12-14). Studies assessing nutrition education intervention and the relationships of knowledge, attitudes or beliefs, and self-efficacy in changing food selection behaviors are presented.

Three behavior change models have been developed to explain how or why people make changes; these models provide constructs for assessing behavior change, and may predict outcomes and guide development of nutrition education interventions. The original health belief model asserts people are motivated to change health behaviors by their perceptions of susceptibility to disease, severity of a disease, benefits of making behavior changes, and barriers to making health-promoting or healthful changes; however, while fear of disease may motivate people to make changes, this motivation continues only while perceived benefits outweigh the perceived barriers to behavior change (9,14, 31, 32). A self-efficacy component, defined as how confident a person is they are able to complete a task, was added to the original model to explain the initiation and maintenance of long-term changes in health behavior (12,31-34). The stages of change model (10), a second model applied to nutrition education (12,13,35-39), has been described as a spiral pattern, with people relapsing and recycling through the stages of precontemplation, contemplation, preparation, action, and maintenance. (10). The third model, social cognitive theory, characterizes behavior change as motivated through interaction of the learner with their environment. These influences include 1) the 3-way interrelationship between learner perceptions, environment, and behavior, 2) expectations and reinforcement, 3) observational learning and modeling, and 4) self-efficacy (13,14,40,41).

An integral component of social cognitive theory of learning, Bandura's expectancy value theory of self-efficacy is a major facilitator or predictor in changing eating behavior (11-13,33,38,41-44). Self-efficacy is a potent motivator, propelling the change process into taking action and sustaining the behavior change. Self-efficacy can be a better predictor of change than past performance. Self-efficacy is task specific, but can generalize to similar situations. Development of self-efficacy uses information from prior accomplishments, practice, feedback, observation of modeling situations or vicarious experience, verbal persuasion, and the arousal of emotions. Self-efficacy is related to the more global perceptions of self-esteem and self-confidence; all 3 impact perceptions and motivation to make or continue behavioral changes.

Figure 2 illustrates the integration of knowledge, attitude, and self-efficacy with the health belief model, stages of change, and social cognitive theory. Nutrition knowledge, facts about basic nutrition, food composition, or relationships between nutrition and disease, facilitates change by altering perceptions, attitudes regarding the need for making changes, and by promoting skills needed to make changes, and enhancing self-efficacy. The role of knowledge is greater in the earlier phases of change processes, as the need for change is identified. Attitudes, beliefs and perceptions, can advance or impede planned behavior change, regardless of the strength of knowledge or self-efficacy.

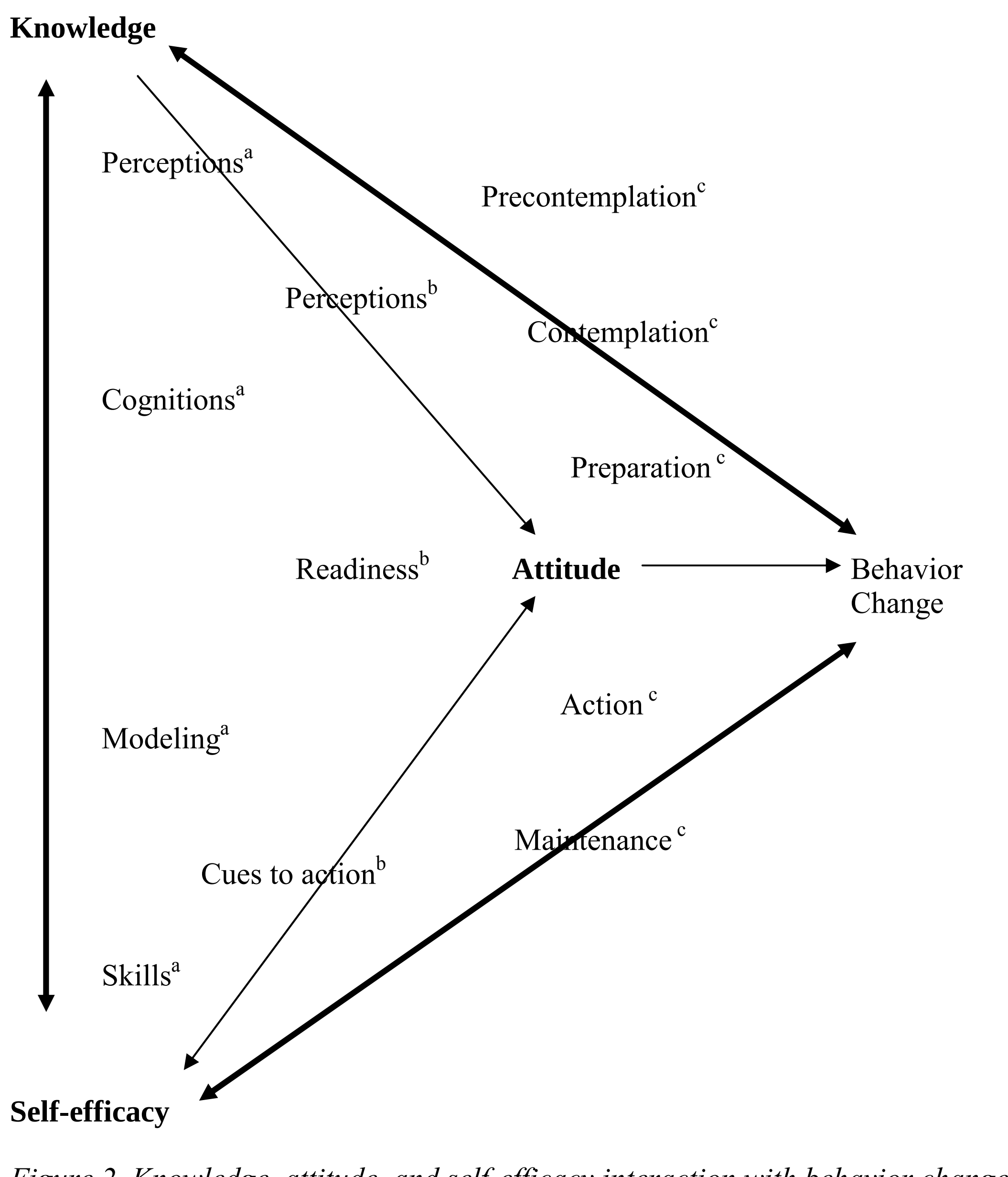

Figure 2 Knowledge, attitude, and self-efficacy interaction with behavior change models

[a] *Social cognitive theory components*
[b] *Health belief behavior model components*
[c] *Stages of change components*

Self-efficacy can promote the change process by altering attitudes, and provides motivation for taking action and maintaining behavior changes.

Changes in nutrient intake have occurred following a college nutrition class (45), interactive computer-assisted instruction (46), and other nutrition education intervention (47). A 1985 meta-analysis of nine studies that examined the relationships of food intake with nutrition knowledge or attitudes related to food and nutrition (48) showed significant relationships, as defined by p values of $\leq .01$, between nutrition knowledge and dietary intake and between nutrition attitudes and dietary intake; however, size-effect calculations indicate the relationships were small. Table 2 summarizes studies of the relationships of knowledge, attitude, and self-efficacy with changes in food behavior. Scores on knowledge instruments were correlated significantly ($p \leq .05$) with attitude scores (49,50), self-efficacy scores (42), and measures of food behaviors such as milk consumption (28), fruit and vegetable consumption (51), general diet (42,50), and label reading and use (49); attitude instrument scores also were significantly correlated ($p \leq .05$) with the same food behaviors (28,49,50). Self-efficacy measures showed significant correlations with behavior (33,42,43), such as decreased consumption of fat and red meat (33), fat intake when assessed both subjectively and objectively (43), and the number of insulin reactions in self-managed diabetic college students (34). Correlations with self-efficacy also were

Table 2 Summaries of the relationship of knowledge, attitude, self-efficacy, and food habits

Reference	Purpose	Subjects	Instruments	Results
Shepherd and Stockley, 1987 (52)	Identify whether nutrition knowledge (K) predicts attitude (A) or food behavior (FB) for fat, fiber, or kilocalories (kcal)	210 United Kingdom adults visiting International Food Exhibition	11 K items on fat, fiber, kcal, 2 7-point (pt) A scales, food frequency questionnaire (FFQ) for milk, meat, fats	Behavioral intention was predicted by attitude but not knowledge.
McDonell et al, 1998 (35)	Compare K, fat intake, and stages of change on readiness to follow a low-fat diet	1081 University faculty, staff	Mailed survey: 11 multiple choice (MC) K items, 17 5-pt Likert-type (LT) A items, 17 FFQ for fat; subjects selected statement for self-rated stages of change (SOC)	Fat intake decreased with progression through stages of change and differed by gender, but did not differ with knowledge.
Frederick and Hawkins, 1992 (28)	Assess relationship between K and A, FB, and bone densities	18 postmenopausal females, 14 female non-athletes, 14 college female dancers, 13 female track athletes	34 true/false (TF) K items, 25 5-pt LT items for A, 24-hour diet recall (DR), FFQ for 30 calcium sources	Knowledge and attitude correlated with FFQ for calcium sources and with milk use.
Marrietta et al, 1999 (49)	Assess K, A, label use behaviors (LB), and their relationships	208 college students in a basic life science course	39 item survey: 9 MC K of label reading facts, 5 5-pt LT A for use, accuracy, truth of label items, 3 5-pt LT general label use B, 17 specific item label use	Knowledge correlated with attitude and label use; attitude also correlated with label use

Table 2 Summaries of the relationship of knowledge, attitude, self-efficacy, and food habits (cont'd)

Reference	Purpose	Subjects	Instruments	Results
Wardle et al. 2000 (51)	Assess relationships of knowledge and fruit, vegetable, and fatty foods intake	1040 English adults	Mailed 110 K items FFQ for fat	Knowledge and female gender predicted both vegetable and fruit intake, and decreased fat intake; young age predicted increased fat and decreased fruit and vegetable intakes.
Kristal et al, 2001 (39)	Study demographic and psychosocial factors predicting healthful change in fat or fruit and vegetable intake	838 adults Washington State Cancer Risk Behavior Survey Fat-related Diet Habits	12 items on dietary fat prior for 3 months on 4-pt scale for frequency, 6 item fruit/vegetable FFQ; items for baseline SOC, diet-cancer beliefs, barriers to healthful diet, label use.	Lower fat-related behavior scores were predicted by stages of change, diet-cancer beliefs, barriers to consuming a healthy diet, label use, age, gender, and education. Greater fruit and vegetable intake was predicted by gender and education; there was a trend with belief in diet-cancer relationships.
Edwards et al 1985 (50)	Assessment of K, A, and FB changes from Red Cross nutrition course	Experimental: 883 adults, sub-sample: 200 at 10-week post-course phone follow-up survey, control: 104 adults from other courses	Pre/posttest/10-week phone follow-up: 15 MC items for K, 8 LT items for beliefs A, 12 LT items for behavior FB	For the experimental group: changes from pre- to posttest, knowledge correlated with attitude and food behavior, and belief correlated with food behavior; no correlations were seen with the subgroup from posttest to follow-up for knowledge, attitude, or belief.

Table 2 Summaries of the relationship of knowledge, attitude, self-efficacy, and food habits (cont'd)

Reference	Purpose	Subjects	Instruments	Results
Slater, 1989 (42)	Assess the influence of self-efficacy (SE) and health knowledge on food behavior	600 adult panel	Surveyed 3x every 18-24 months over 6 years; 32 K MC, 10 SE 6- or 9-pt LT items, 6 LT items for social influences and 12 LT cognitive control indexes; 11 item FFQ and 24h DR	Knowledge and self-efficacy both correlated with food behavior. Self-efficacy and knowledge were also correlated.
Contento and Murphy, 1990 (33)	Assess psychosocial influences on voluntary change in food habits	65 shoppers reporting self-change in diet, 52 shoppers with no diet change	Interview for SE at grocery then the rest of the instrument was completed and returned by mail; 29 food items for B, 96 5-pt LT items for 12 psychosocial scales	Self-efficacy and perceived benefits and barriers were correlated with reported self-change of food habits.
Ounpuu et al, 1999 (38)	Validation of self-efficacy scales for fat reduction	468 Canadian females	Mailed 17 5-pt LT for SE for 3 situations of good feelings with positive social aspect, bad feelings in a negative situation, and inconvenient to eat low-fat foods	Self-efficacy increased between action and maintenance stages of change. Self-efficacy in the three situations was correlated.
Hinton and Olson, 2001 (44)	Assess relationship of psychosocial factors, exercise, and food behaviors 1-year postpartum	468 postpartum females	Mailed FFQ 2x prenatal and 2x postpartum; 5-pt LT SE items: 2 on exercise, 7 on avoiding overeating, 4 on consumption of "healthy foods", 21 for other factors	Linear regression found food intake was associated with self-efficacy for avoiding overeating and for eating "healthy foods".

Table 2 Summaries of the relationship of knowledge, attitude, self-efficacy, and food habits (cont'd)

Reference	Purpose	Subjects	Instruments	Results
Brug et al, 1994 (43)	Assess awareness of fat intake and intention to reduce fat intake	1507 adults at beginning of Dutch cancer prevention project	Mailed 25 FFQ for objective fat intake, 3- to 5-pt bipolar LT scales for self-rated subjective fat intake, scales for: SE, sum of beliefs (expectancy value A), modeling (social cognitive theory), direct A (good/bad), direct social influence, indirect social influence, intention	Self-efficacy, modeling, social influence, sum of beliefs, and direct attitudes correlated with both subjective and objective fat intakes. All correlations with intakes except self-efficacy were greater for subjective fat intake. Psychosocial variables had little relation to intake for those with higher subjective than objective fat intake.

seen within later stages of change (38), and with perceptions of benefits and barriers from the health belief model (33,43).

Findings regarding the significance of correlations of knowledge measures with attitudes or food behavior, or attitudes with food behavior have been inconsistent. Shepherd and Stockley (52) surveyed visitors to a London International Food Festival for knowledge of fiber, fat, and kcal content of foods, consumption of meat, meat products, butter, margarine, and whole fat milk and attitudes toward eating these types of foods. They reported a significant correlation of attitude scores with intake of meat, butter/margarine, and whole milk, but found no significant correlations between knowledge and attitude survey scores or knowledge and consumption of the foods listed. The investigators suggested that a longer knowledge test may have better differentiated subjects by knowledge, or that nutrition knowledge may have related to general attitudes more than attitudes toward specific foods included in their attitude survey. A second study by McDonell, Roberts, and Lee (35), included comparison of the knowledge of dietary fat and the frequency of saturated fat intake of 1081 Australian university faculty and staff grouped by self-reported stages of change, gender, and job level. Although knowledge scores were significantly greater for faculty than general staff, fat frequency intake scores for the 2 groups did not differ. Across the 5 stages of change, knowledge scores did not differ but fat frequency intake scores did decrease significantly ($p \leq .01$); for males, fat intake scores changed from 29 in the precontemplation stage to 20 in the maintenance stage, while intakes for females decreased from 25 to 19, respectively. Similarly, between males and females, knowledge scores did not differ, but fat intake scores indicated the percentage of fat in the diet was significantly greater for males than for females.

Positive correlations have been reported between knowledge, attitudes, and for some food behaviors, but not for others. Frederick and Hawkins (28) identified a highly significant correlation ($p \leq .001$) between knowledge scores and calcium intake from food frequency data of college-age and postmenopausal females. Significant correlations also were found for attitude with both food frequency data for foods rich in calcium and for the milk use subset, and for knowledge and milk use. In a second study, that evaluated knowledge, attitudes, and label use in students in a basic life science college course, Marrietta et al (49) reported that knowledge correlated with general label use, attitude, and use of specific label information; attitudes were highly correlated with label use. Multiple regression analysis showed attitude and female gender to correlate with label use behaviors (49). Wardle, Parmenter, and Waller (51) reported that knowledge scores, for 1040 British adults surveyed, correlated with greater fruit or vegetable intake, and with reduced fat intake. Logistic regression analysis indicated knowledge was positively related with fruit or vegetable intake, but inversely related with fat intake. Kristal, et al, (39) studied fat-related diet habits of 838 adults participating in the Washington State Cancer Risk Behavior Survey and described linear regression associations for decreased fat-related behavior scores with stages of change, diet-cancer beliefs, barriers to fat intake, label reading, gender, age, and years of education. Greater fruit and vegetable intake related to gender and years of education, with a trend also noted for diet-cancer beliefs.

Following an American Red Cross nutrition course, Edwards, Acock, and Johnson (50) reported changes in both knowledge and attitude scores correlated with change in food behavior scores; change in knowledge and attitude scores also were correlated. However, no significant correlations were observed for changes in knowledge, attitude, or food behavior from the post-intervention to a 10-week follow-up survey. Posttest scores for knowledge, beliefs, and food behaviors significantly increased compared to pretest scores; although knowledge and belief scores decreased at a 10-week follow-up survey, food behavior scores continued to increase at the 10-week follow-up compared to pre- and posttest scores. The continued increase in behavior scores, and concurrent lack of significant correlation between knowledge, attitude, and behavior at follow-up, led investigators to hypothesize that changes in behavior may become self-reinforcing (50); perhaps they were looking at self-efficacy.

Self-efficacy has been shown to correlate with food behaviors. Slater (42) analyzed survey interview data for 600 subjects from the 2 control towns in the

Five City Project of the Stanford Heart Disease Prevention Program; indices measured were eating behavior, self-efficacy, health knowledge, cognitive control, and social influences. Knowledge was correlated with eating behaviors, self-efficacy, and gender; self-efficacy also was correlated with behavior and age. When self-efficacy was the dependent variable for hierarchical regression analysis, the relationship with behavior continued to be significant, but those with knowledge and gender were no longer seen. When eating behavior was the dependent variable, relationships with knowledge, self-efficacy, and age continued.

Contento and Murphy (33) evaluated differences in grocery shoppers not reporting changes in food habits, and those that had voluntarily decreased intake of red meat or butter, and/or changed intake of salt, fat, sugar, fruits and vegetables, and processed or whole grains. Twelve psychosocial scales were assessed, including self-efficacy, perceptions of susceptibility, severity, benefits, barriers, cues to action, and overall health concern from the health belief model, self-efficacy, normative beliefs, motivation to comply, and 3 locus of control scales. Questions regarding changes in intake of 29 foods and self-efficacy scale questions were obtained during in-store interviews; subjects completed the remainder of the questionnaire at home and returned it by mail. The authors reported a small, but significant correlation in self-efficacy scores and changes in food habits, and noted confidence in food preparation skills to be a principal factor for changing fat and red meat consumption.

In Canadian females, Ounpuu, Woolcott, and Rossi (38) validated scales that measured self-efficacy for the avoidance of high-fat foods in 3 situations: good feelings with positive social aspects; bad feelings with a negative situation; and inconvenient circumstances for eating low-fat foods. The task or situational-specificity across stages of change was apparent as self-efficacy scores significantly increased between the preparation and action stages for both positive and difficult situations, but significantly increased between the action and maintenance stages for negative situations. The researchers also noted that the high correlation between mean rating scores for the 3 situations indicated a relation to a more global self-efficacy factor. In a second study, reported by Hinton and Olson (44), food behavior-specific self-efficacy was a psychosocial variable assessed in postpartum females. Four times from the second trimester of pregnancy through 1 year postpartum, subjects completed food frequency questionnaires and questionnaires to assess activity, food intake, and psychosocial scales that assessed self-efficacy for consumption of healthful foods, food intake (avoidance of overeating), exercise, and weight control. Additional scales addressed locus of control for weight, weight gain with pregnancy and age, achieving thinness, body satisfaction, social support, and motherhood. Multivariate analysis indicated self-efficacy regarding excess food intake, body satisfaction, weight gain acceptance, and drive for thinness predicted decreased food intake. The investigators concluded that successful interventions promote behavior-specific self-efficacy.

Dutch adults in a cancer prevention intervention project were surveyed for fat intake and psychosocial factors (43). Fat intake was assessed by a short food frequency for fat intake, (objective fat) and an item asking subjects to rate their fat intake from very low to very high (subjective fat); subjects were classified as realistic if objective and subjective fat were similar, optimistic if subjective fat was lower than objective fat, and pessimistic if subjective fat was higher than objective fat. Psychosocial scales asked subjects to rate: beliefs relating taste or health problems to selecting high-fat diets, high fat diets on good/bad or pleasant/unpleasant scales, the level that significant others encouraged use a of low-fat diet, the fat intake of significant others, trouble resisting high fat foods in high-risk situations such as parties (self-efficacy), and intention to reduce fat intake. Self-efficacy was correlated with both objective and subjective fat intake. For subjects unrealistic about their fat intake, self-efficacy was more significant for subjective fat responses than for objective fat intake assessment. Brug et al (43) suggested that subjective behaviors may change with nutrition education intervention; as almost half of those surveyed underestimated their fat intake, the authors hypothesized increasing awareness of fat intake might encourage interest in reducing fat intake.

Knowledge, attitude, and self-efficacy may interact with the planned change process either individually or indirectly through each other. Additional factors reported to have been significantly correlated with food behavior change are: gender with knowledge (35,51), behavior (35,49), and stages of change (35), stage of change with knowledge and behavior (35), perceptions of benefits and barriers correlations with behavior change (33), and age correlations with knowledge (51) and self-efficacy (42). Observed variability of the contributions of knowledge, attitudes and self-efficacy to eating behaviors indicates that it is extremely difficult to change eating habits with a single approach. In summary, facilitating changes in eating behaviors cannot rely on one model or strategy for change. Educational intervention must be targeted to the audience and promote self-efficacy.

MULTIMEDIA IN EDUCATION

This section reviews the use of multimedia in nutrition and medical education. Strengths of interactive multimedia (IMM), such as actively engaging the learner, addressing multiple learning styles, making abstract concepts concrete, organizing information, and interaction with, and simulation of the environment are discussed. Studies evaluating efficacy and user acceptance of computer-assisted instruction (CAI) and IMM are presented.

IMM requires active involvement of the learner, augmenting attention to the task, which is essential for the selection and initial processing of information in short-term memory. Actively involving the learner also boosts the organization of information, interest in the subject, and retention of material presented (15-17, 53-55). The concurrent use of multiple stimuli, such as visual images, audio effects, interactions and feedback, or physical interaction with keyboard, mouse, or other input mechanism, actively engages multiple senses simultaneously; thus IMM can be a more powerful teaching tool than using a single channel of sound or visual input alone (56).

IMM meets a variety of learning style needs through combinations of instructional strategies and presentation media. The use of images, narration, sound, animation, video, and physical interaction with the computer system address needs of auditory, visual, and kinesthetic learning styles. The self-paced, individualized learning approaches of IMM allow learners to proceed through programs via structured routes (53,57,58), yet facilitate exploration and discovery of the same information by other learners. This self-control of learning makes the material presented more meaningful, increases attention, and enhances depth of processing and organization in memory. The multiple approaches incorporated into IMM also help make abstract concepts concrete (17,53). IMM presents standardized information in controlled chunks and sequences that enhance organization of information by the learner; this allows the learner to review and practice as needed while gaining confidence and competence. IMM programs can guide learners through problem solving models and provide opportunities for interacting with simulated environments (17,59); interactive programs can replace inconsistent or limited experiences, or expensive or dangerous situations and increase practice opportunities. IMM programs, from tutorials to simulations, must keep the learner interested, provide meaningful material, provide motivation, and assist in elaborating on current memory to enhance processing, retention, and transfer of knowledge.

Table 3 summarizes the effectiveness and acceptability of multimedia used in nutrition education of college students, dietetics students, and medical students. Multimedia programs have been used: to enhance traditional lecture (53,57), as a study guide for lectures (60,61), for drill-and-practice (55,59,62), to provide tutorials (46,55,57,58,63-65), and for simulations (57-59,64,65). Programs have covered such topics as basic nutrition and digestion, nutritional assessment, development of care plans, cardiovascular disease, nutrition in cancer, medical physiology, and prescription of diabetic diets.

Knowledge scores, performance, and attitudes toward use of CAI and IMM have increased after program use. By simply adding computer-based aids to lecture, Beerman (53) reported increased mean course grades for introductory nutrition classes. Mean grades of 82 ± 10.9 and 84 ± 10.8 for classes, in 1994 and 1995, with computer-enhanced lecture were significantly greater than the mean grades of 77 ± 17.6 and 77 ± 13.8 ($p \leq .05$) for 2 classes in 1992 and 1993 without computer-enhanced lecture. However, Richardson (57) described mean test

Table 3 Summary of effectiveness and acceptability of multimedia in nutrition, medical, and science education

Reference	Purpose	Subjects	Instruments	Results
Beerman, 1996 (53)	Assess effect of multimedia enhanced lectures	Introductory nutrition students over 4 years; 142 from control (C) - overheads used with lecture, 147 from experimental (E)- used computer based media to enhance lecture	Four course exams 25 multiple choice (MC) knowledge (K) items, 3 essay questions, 95% same questions used each semester	Year n Mean test score C 1992 67 77.1±17.6^{x} C 1993 75 76.6±13.8^{x} E 1994 79 81.6±10.9^{y} E 1995 68 84.2±10.8^{y} 75% rated multimedia as excellent in facilitating learning ^{xy}means with different superscripts are significantly different at p≤0.05
Richardson, 1997 (57)	Compare learning and perceptions for lecture, computer-assisted lecture and computer laboratory assignments	92 medical physiology students taught through lecture, lecture with computer lecture aids, computer lab with post lab write-up	Similar material on tissue blood flow and, muscle mechanics were presented by all three methods; 15 MC K posttest, 5 items from each method, 10-point (pt) attitude (A) ratings questionnaire	Mean percent correct for knowledge scores was significantly greater (p≤0.05) for computer lab (94.3%) compared to lecture (86.6%) or computer-assisted lecture (89.8). Ratings on effectiveness were significantly greater (p≤0.0001) for lecture than computer lab or computer assisted lecture.
Carew et al, 1984 (61)	Evaluate usefulness of Computer-Assisted Instruction (CAI) in a nutrition class	Introductory nutrition students- Experimental: 76 volunteers, Control (C): 192 nonusers	Compared course grades for all; questionnaire about programs for users at course end; 11 CAI files for use as basic nutrition and nutrients study guide; on university mainframe computer only	The mean course grades of 81.3% for experimental and 76.2% for control groups differed significantly (p≤0.001). Students rated the CAI program as useful, but preferred lecture.

Table 3 Summary of effectiveness and acceptability of multimedia in nutrition, medical, and science education (cont'd)

Reference	Purpose	Subjects	Instruments	Results
Ries and Granell, 1985 (62)	Compare CAI effectiveness with lecture/ discussion	Introductory foods and nutrition students: 14 used CAI program on vegetarianism, 16 given lecture/ discussion on vegetarianism (LD) 14 were taught another topic with menu planning assignment	Pretest, CAI/LD, post test 3 wk after completion of CAI/ LD, 48 MC items for K on vegetarianism 1 3-pt A item on interest in vegetarianism. 1 item on computer use, 3 4-pt items on use of the CAI lesson.	Pretest and posttest knowledge scores did not differ among the treatment groups. Mean test scores (± standard deviation): Group Pretest Posttest CAI 32.7±6.5 (68%) 37.0±5.1 (77%) Lecture 32.3±7.1 (67%) 25.3±4.8 (53%) Control 34.8±7.1 (73%) 34.1±7.8 (71%) The CAI was rated ≥3.3, on 4-point scales, as satisfying, motivating, and interesting. Small sample size contributed to lack of statistical significance.
Kumar et al, 1993 (46)	Assess effectiveness of CAI on nutrition and cancer	92 upper level students from educational psychology class: 32 Interactive CAI (ICAI), 31 non-interactive CAI (NCAI), 29 taught using paper/prose – text version of NCAI (PP)	Pretest (Pr), posttest1 (P1), posttest2 (P2) at 3 weeks post CAI, 50 Fill-in K, 4-day food record (FR) 4-week pre-and 3-week post-CAI program "Diet, Nutrition and Cancer Prevention"; FR evaluated for kilocalories (kcal), fat, % change in fat, vitamin A, vitamin C, and crude fiber.	ICAI NCAI PP Test score percentage Pr 41±1.7^{x} 41±1.8^{x} 42±1.7^{x} P1 83±1.4^{x} 78±1.9^{y} 78±1.9^{y} P2 75±1.3^{x} 62±2.1^{y} 64±1.6^{y} Percent change Pr to P1 41±1.9^{x} 37±1.6^{xy} 36±2.0^{y} Pr to P2 33±1.8^{x} 21±2.4^{y} 22±1.9^{x} Change fat 41.8%^{x} 26.1%^{y} 18.6%^{x} Pretest knowledge, baseline kcal and nutrients and post-intervention vitamins and fiber were not significantly different between intervention groups but kcal and fat differed significantly between ICAI and PP groups. ^{xy}means with different superscripts in each row are significantly different at p≤0.05.

Table 3 Summary of effectiveness and acceptability of multimedia in nutrition, medical, and science education (cont'd)

Reference	Purpose	Subjects	Instruments	Results
Raidl et al 95 (55)	Assess effectiveness of CAI for teaching clinical reasoning skills in dietetics students	Dietetic students: 135 used drill-and-practice CAI program, 130 used CAI tutorial, 148 controls.	CAI programs for clinical reasoning skills; all subjects completed the same simulation test program	Simulation program test scores: % Correct (mean ±standard deviation) Control Drill Tutorial 68.6 ± 10.1^{x} 71.3 ± 8.6^{x} 78.3 ± 11^{y} Tutorial group mastery of 4 of 6 objectives was significantly greater ($p\leq0.01$) than control or drill groups; tutorial and control group mastery of objectives did not differ significantly.
Byrd-Bredbenner et al, 1991 (63)	Develop and assess CAI modules for nutrition education	159 introductory nutrition students, grouped: Pre-/posttest, 50 used 7 CAI modules, and 49 controls completed pre-/posttest; additional groups completed CAI modules and posttest or posttest only	50 MC K items, 20 5-pt LT A items for computer use included enjoy use and, helped learning, 5-pt LT A items regarding individual module use.	Means adjusted for pretest scores of pre-/posttest groups differed for all modules; the differences were more robust ($p\leq0.001$) for modules on carbohydrate, lipid, protein, digestion, and energy balance than for vitamin and mineral modules ($p<.05$). Module (items) CAI group Control group (Mean scores ± standard error) Vitamin (3) 1.7 ± 0.1 (57%)^{x} 1.4 ± 0.1 (47%)^{y} Mineral (10) 7.7 ± 0.2 (77%)^{x} 6.0 ± 0.2 (60%)^{y} Students rated programs ≥ 3.4 of 5 for enjoyment and help in learning. ^{xy}means with different superscripts in each row are significantly different at $p\leq0.05$.

Table 3 Summary of effectiveness and acceptability of multimedia in nutrition, medical, and science education (cont'd)

Reference	Objective	Subjects	Instruments	Results
Turner et al, 2000 (59)	Assess use of CAI simulation on clinical skills of dietetic interns	108 dietetic interns, 56 used multimedia care planning simulation CAI (S), 52 used nutrition assessment tutorial drill-and-practice CAI (T)	33 5-pt behavior evaluation for 8 categories of clinical performance 12 5-pt LT for program A and evaluation	No significant difference was observed in overall performance between groups. Slopes of performance rating curves over 8 weeks indicated simulation groups showed greater ($p \leq 0.05$) rate of improvement for obtaining data, interviewing, and analyzing data than CAI tutorial groups. Student program ratings indicated the feedback was useful, and the simulation program was more effective than traditional paper case studies.
Kolasa et al, 1997 (58)	Assess knowledge, performance, and attitudes of medical students after use of a nutrition multimedia program.	144 1st year medical students over 2 yrs; 16 evaluated for counseling skills	CAI on nutrition assessment and counseling for cardio-vascular disease and Step 1 diet replaced 60 minute lecture; required 1 clinical challenge, 1 self-assessment; printout documented completion; interactive video assessment -15 5-pt LT A + 4 written A; Trained observers evaluated counseling skills; Tracking added and problems corrected for 2nd year of CAI	In the 16 students observed post-CAI, counseling improved, e.g., use of dietary assessment tool, food frequency questionnaire tool. Student mean ratings (5-point) included: Informative - 3.7, good use of time 2.9, prefer CAI to lecture - 2.8, and seeing physician's modeling helped - 3.5

Table 3 Summary of effectiveness and acceptability of multimedia in nutrition, medical, and science education (cont'd)

Reference	**Objective**	**Subjects**	**Instruments**	**Results**
Kohlmeier et al, 2000 (65)	Assess efficacy of a CAI module on nutrition and cancer	163 1st year medical students; subgroup of 38 for (posttest2)	Module completed over 2-week period. 20 MC K items (40 similar questions); 5-pt LT A/SE items regarding knowledge and ability to advise clients on cancer and nutrition. Pretest K and pre-/posttest A and self-assessment items sent via e-mail, posttest K on midterm, posttest2 3 months later, 15 5-pt LT A/SE and perceived K	Knowledge score (mean percent) Pretest 22.3±9.9% Posttest 86.3±10.7% Posttest2 61.2±13.1% The mean change from pretest to posttest was significant ($p \le 0.001$). Self-assessment and attitude ratings increased significantly ($p \le 0.05$) from pre- to post-intervention regarding the need to know nutrition issues essential in cancer (78.2% vs. 89.4%), felt knowledgeable about cancer issues (4.5% vs. 59.8%), and ability t0 advise on nutrition in cancer (5.7% vs. 66.9%).
Engel et al, 1997 (64)	Assess a CAI program on diabetes nutrition education for medical students	Experimental: 41 3rd year medical students (M), Controls: 12 nurses (N) and 5 dietitians (D)	Interactive CAI: modules for needs assessment, diabetic diet pattern, diabetic exchanges, carbohydrate counting; 2 10-item MC K test forms 5-pt LT for self-efficacy (SE) computerized tests for M, paper tests for N, D	M N D Mean score (10 item) ± standard deviation Pretest $3.7±1.7^x$ $3.8±2.3^x$ $7.9±1.4^y$ Posttest $6.4±2.0^x$ ---------- $7.8±1.0^x$ Medical student self-efficacy scores: Pre: $13.5±5.1^x$ Post: $30.2±5.9^y$ Knowledge and self-efficacy scores for medical students increased significantly after CAI ($p \le 0.0001$) ^{xy}means with different superscripts in each row are significantly different at $p \le 0.05$.

Table 3 Summary of effectiveness and acceptability of multimedia in nutrition, medical, and science education (cont'd)

Reference	Objective	Subjects	Instruments	Results
Carew et al, 1997 (60)	Evaluate usefulness of computer-assisted instruction (CAI) in a nutrition class	Introductory nutrition students: 160 volunteer CAI users (E), 83 nonusers (C)	50 MC K items pre-/ posttest, 11 4-pt Likert-type (LT) A toward CAI items, 14 items for demographic and computer use; 11 CAI files for use as study guide	Mean gain on posttest scores for users was significantly greater ($p \leq .04$) when controlled for college, and showed a trend ($p < .06$) when controlled for class level. Attitude ratings for CAI use significantly increased ($p \leq 0.05$) for items indicating the CAI program as helping to better understand concepts and improve learning skills, but also that the CAI program was too time consuming. 87% rated the program as very useful to useful

scores for medical students in computer-aided physiology lectures of 90% that were not significantly greater than the 87% scores for those in traditional lectures. In a study assessing the use of an interactive, non-multimedia CAI study guide (61), introductory nutrition students that used the CAI program had mean course grades of 81% compared to 76% for controls ($p \leq .001$). Ries and Granell (62) reported no significant difference in pre- and post-intervention scores of introductory nutrition students completing a CAI program on vegetarianism, students receiving a lecture on vegetarianism, and students receiving a lecture on another nutrition topic; however, the CAI group scores increased from 33 ± 6.5 (68%) to 37 ± 5.1 (77%), while the scores for the lecture and control groups decreased from 32 ± 7.1 (67%) to 25 ± 4.8 (53%) and from 35 ± 7.1 (73%) to 34 ± 7.8 (71%), respectively. The authors suggested that the small numbers of subjects and relatively high level of beginning knowledge of the limited topic might have contributed to their inability to demonstrate significant differences in performance between the groups.

Kumar, et al (46) compared the knowledge scores and food records of educational psychology students before, after, and 3-weeks after an educational intervention about nutrition and cancer with an interactive CAI program, non-interactive CAI program, or paper version of the non-interactive CAI program. The mean pretest scores for all 3 groups of 41% to 42% did not significantly differ; although all post-intervention scores increased, the mean score for the interactive CAI group was 83 ± 1.4%, significantly greater ($p \leq .05$) than the 78 ±1.9% for each of the other groups. Mean scores 3-weeks post-intervention decreased to 75 ± 1.3%, 62 ± 2.1%, and 64 ± 1.6% for the interactive CAI, non-interactive CAI, and paper groups, respectively; the average score for the interactive CAI group remained significantly greater ($p \leq .001$) than those of the other groups. Mean change in scores from the pre- to the posttest of 41 ± 1.9% and 37 ± 1.6% for the interactive CAI and non-interactive CAI group, did not differ significantly, but both change scores were significantly greater ($p \leq .05$) than the change score of 36 ± 2.0% for the paper group. From the pretest to the 3-week follow-up posttest, the mean change score for the interactive CAI group (33%) was significantly larger ($p \leq .05$) than gains for both the non-interactive CAI group (22%) and the paper group (21%). Post-intervention energy intakes were significantly higher for the paper group compared to both CAI groups; energy consumption did not differ between CAI groups. A significantly greater decrease in fat intake was observed for the interactive CAI group in contrast to those of the noninteractive CAI and paper groups; changes in fat intake for the latter groups did not differ significantly. Pre- and post-intervention consumption of vitamin A and vitamin C did not differ with instructional method.

Knowledge and performance of dietetic students have improved with completion of IMM modules. Studies by Raidl et al (55) and Byrd-Bredbenner and Bauer (63) observed that knowledge scores for subjects completing tutorial programs were at least 10% greater ($p \leq .05$) than knowledge scores for students completing drill-and-practice programs or receiving no multimedia intervention. Turner et al (59) reported that the mean clinical final performance evaluation ratings of dietetic interns completing a CAI simulation program for care planning did not differ significantly from the mean final performance evaluation of interns completing a CAI drill-and-practice program. However, slopes of performance rating curves over the 8-week clinical rotations indicated the rate of improvement was significantly greater for those completing the simulation program than for those completing the tutorial program ($p \leq .05$).

Knowledge scores, clinical performance, and self-efficacy scores have improved for medical students following use of CAI simulation programs. Although mean test scores of medical students in a physiology class did not significantly differ with CAI enhanced lecture or traditional lecture, the mean test score of 94% was significantly greater ($p \leq .05$) for those completing the CAI lab simulation than for material covered in either lecture (57). Kolasa et al (58) reported increased use of a dietary assessment tool and food frequency questionnaire by medical students, following implementation of a IMM program on nutritional counseling; students especially liked the modeling of assessment and counseling by a physician depicted in the IMM program. Following use of an IMM cancer and nutrition module, Kohlmeier et al (65) observed knowledge scores of medical students increased from 22 ± 9.9% to 86 ± 10.7% ($p \leq .001$); scores 3 months later decreased to 61 ± 13.1% (65). Self-efficacy scores regarding the ability to counsel on nutrition and cancer, importance of the need to know about nutrition and cancer issues, and knowledge of these issues increased as much as 12-fold. Following use of a skill-building IMM program on nutritional care in diabetes, Engel et al (64) also found medical students' mean knowledge scores increased 73% from 3.7 ± 1.7 to 6.4 ± 2.0 ($p \leq .0001$), and did not differ significantly from the 7.8 ± 1.0 mean post-intervention score of dietitians tested; medical students' mean self-efficacy scores more than doubled ($p \leq .0001$) from the pre- to the posttest.

Attitudes toward use of computer programs have been favorable (58-63). Following the use of multimedia programs, attitude scores toward both CAI in general and specific programs improved at $p \leq .05$ or greater.(60,63). In general, subjects found multimedia programs helpful or useful (60,61). Although knowledge scores reflected improved performance with CAI use, some subjects felt the programs used their time less efficiently than traditional lecture (57,58,61).

These studies indicate IMM is an accepted tool to enhance learning. Attitudes toward computer-based instruction were positive, but not consistently significant. With the increased computer literacy of young adults, and the expansion of web-based and distance education, IMM is an ideal tool for nutrition education to promote self-efficacy and food behavior change.

RESEARCH GOALS

The present study tests the hypothesis that students enrolled in introductory and advanced courses in nutrition using an IMM instructional program on calcium and folate as part of their nutrition curricula will show: 1) a greater increase in knowledge of good food sources of calcium and folate, 2) greater self-efficacy toward selecting diets providing good sources of calcium and folate, 3) more positive attitudes toward selecting good food sources of calcium and folate, and 4) for introductory students, a more positive change in intake of calcium and folate than students receiving traditional instruction. According to results of previous studies (Table 3), students completing the IMM modules should demonstrate increased knowledge scores for calcium and folate questions. Incorporation of opportunities to practice skills of identifying or selecting good sources of calcium and folate are expected to help develop self-efficacy as reflected in increased self-efficacy rating scores. Knowledge and self-efficacy have been shown to influence attitude, thus attitude rating scores for statements regarding good sources of calcium and folate should increase. Finally, greater knowledge, self-efficacy, and more positive attitudes may improve selection of foods rich in calcium and folate as reflected by increased consumption of calcium and folate assessed by analysis of 1-day food records for introductory nutrition students.

Chapter 3: Methods

The purpose of this investigation was to develop and evaluate the effectiveness of an interactive multimedia (IMM) program on food composition. Effectiveness of the IMM program for promoting change in knowledge, attitudes, self-efficacy, and food habits was evaluated using college students enrolled in introductory and advanced nutrition classes at multiple locations. Four nutrients, calcium, folate, iron, and vitamin A, were selected as topics of the IMM; this dissertation will focus primarily on results relating to 2 of the nutrients, calcium and folate.

Learning objectives for the IMM program were constructed that included identifying: the Dietary Reference Intakes/Recommended Dietary Allowances (DRI/RDA), significant food sources of the nutrient, foods with greater nutrient density, and meals providing the greatest amount of the specified nutrient. A cognitive needs assessment was completed using pretests developed from the learning objectives that were administered to students enrolled in introductory and advanced nutrition courses at 6 universities across the United States. Following the needs assessment, the IMM program, *SmartBytes*, was developed. Students enrolled in introductory nutrition and graduate education classes, nutrition faculty and education specialists provided periodic feedback on prototype sections of the program. Item analyses of the pretest items were reviewed; items that did not adequately discriminate between high and low performers on the test were revised or discarded. Attitude and self-efficacy items were generated and combined with revised cognitive test items for 2 pre-/post-intervention evaluation instruments, 1 each for introductory and advanced nutrition students. Subjects enrolled in introductory nutrition classes completed pre- and post-interventions and provided 1-day food records at the beginning and end of the testing period; those assigned to the experimental group also reviewed *SmartBytes* and completed a feedback questionnaire during the post-intervention assessment. Advanced nutrition subjects followed the same protocols but did not provide 1-day food records. Final data collection occurred fall 2000 through summer 2001 at 7 universities across the United States. Figure 3 provides an overview of the project timeline.

SUBJECTS

A total of 722 introductory and 197 advanced nutrition students, ages 17-72 years were recruited from nutrition classes at universities in Arkansas, California, Delaware, Florida, Indiana, Iowa, Oklahoma, and Texas. Since the investigation was incorporated in regular class activities, the Human Subjects Review Board at the University of Texas at Austin approved the research protocol and determined consent forms were not required; human subjects review committees at the other sites also reviewed the testing protocols to meet the requirements on their respective campuses.

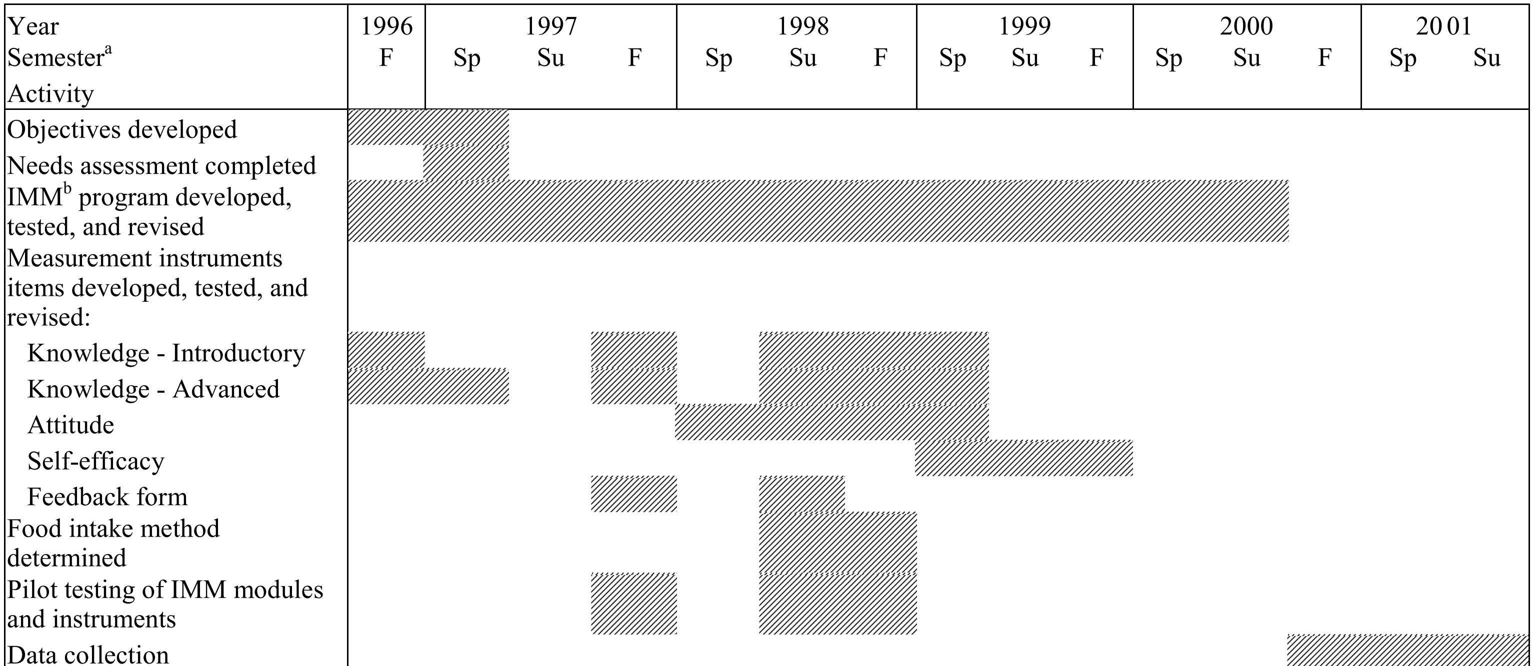

Figure 3 Project timeline

[a] Fall (F), Spring (Sp), Summer (S)

[b] Interactive multimedia program (IMM)

PROGRAM OBJECTIVES

The investigator, in cooperation with the project research team that included 2 professors and another graduate student, developed learning objectives for the IMM modules. The selection of the nutrients, calcium, folate, iron, and vitamin A, was guided by intake surveys that reported inadequate consumption of the selected nutrients by young adult Americans (6,7). Learning objectives targeted: knowledge of the DRI and number of servings of a given food to provide 5% to 30% of the DRI; identification of rich and poor sources; and the concepts of nutrient density and bioavailability. For advanced students, the evaluation of diet histories for adequacy of target nutrients was an added objective. Program objectives for calcium and folate are listed in Appendix A.

NEEDS ASSESSMENT

Needs assessment testing was done to determine the adequacy of knowledge of young adult college students of the nutrient composition of foods, especially for the target nutrients. Multiple choice cognitive tests were developed from the program learner objectives. The test for introductory nutrition students included 32 questions divided between the 4 target nutrients; the test for the advanced nutrition students included an additional 8 questions that required students to assess nutrient content of the 4 nutrients for 2 diet records. The tests are found in Appendix B. The tests were administered to introductory and advanced nutrition students at 6 universities during the spring term, 1997. At the beginning of the semester, 393 participating students from introductory nutrition classes, scored a mean of 10.0 ± 3.3 (standard deviation) out of 32, or about 31%; the mean score for 129 advanced nutrition students was 14.2 ± 2.9, or 44% for the same 32 questions. On average they answered 5.0, or 57.5% of the additional 8 items regarding menu evaluation correctly. These scores indicated the need for improved acquisition and retention of food composition knowledge for both introductory and advanced nutrition students. Results were presented at the American Dietetic Association Annual Convention during fall 1997 (18,19). Abstracts of the results are found in Appendix C.

PROTOCOL AND DATA COLLECTION

The testing protocols for traditional curriculum (TC) control groups and the IMM enhanced (IMM) curriculum experimental groups are summarized in Table 4. Packets of materials distributed to all participating sites included pre- and post-intervention instruments, computer-scanned answer sheets, 3½ inch floppy diskettes for food records, and instructions for preceptors. For experimental groups feedback questionnaires were a part of the post-intervention instrument, and copies of the compact disk IMM program, *SmartBytes*, also were included. Copies of the test instruments are provided in Appendix D; copies of preceptor instructions and feedback questionnaires are shown in Appendix E. Preceptors from both control and experimental groups were asked to administer the post-intervention instruments at least 4 weeks after pretests were completed.

Food records for introductory students also were to be collected at least 4 weeks apart. Students in the IMM groups were asked to complete the feedback form only if they had completed all 4 nutrient sections. Completed answer sheets and food records were returned to the investigators by mail.

Table 4 Summary of experimental protocol

Group:	**Introductory** Control n=210	Experimental n=208	**Advanced** Control n=60	Experimental n=122
Teaching method:	Traditional curriculum	IMM enhanced curriculum	Traditional curriculum	IMM enhanced curriculum
Instruments:	Pre-/posttest 1-day food records	Pre-/posttest 1-day food records Feedback form	Pre-/posttest	Pre-/posttest Feedback form
Intervention:	None	*SmartBytes*	None	*SmartBytes*

MULTIMEDIA PROGRAM

The IMM nutrient modules were developed to meet the established objectives for calcium and folate (Appendix A), and as presented in a separate dissertation, for iron and vitamin A. Nutrient modules were subdivided into 4 sections that presented:

1) DRI/RDA – a) the current DRI/RDA, and b) the number of servings needed to meet a given percentage of the DRI;

2) Sources – a) a comparison of foods that provide 5%-30% of the DRI, according to the specific nutrient;

3) Nutrient density – a) how the concentration of nutrients in different foods can be calculated and compared using the Index of Nutrient Quality, nutrient content per serving, and nutrient content per 100 grams, and b) conditions that alter content of the nutrient in food or meals;

4) Applications – a) practice selecting foods or meals to meet specified amounts of a nutrient, and b) identifying adequacy of a nutrient in a given diet history.

A calculator, glossary/definitions, program map, nutrient tables per serving and per 100 gram portions, and a table of serving sizes were available as part of the program. A flow diagram of the program is shown in Figure 4.

The program was created using Authorware 3.5 authoring program (66) with graphics prepared using Adobe Photoshop 5.5 (67). The organization of the program was developed following suggested principles of multimedia interface design (68), learning theories (40), and instructional system design (69). Food examples in the program were selected if they were frequently consumed by adults (70) or college-aged persons (71) in the United States, or could be classified as "good" sources that provided at least 10% DRI in a standard serving (72); for nutrients with few sources that provided 10% of the DRI, foods

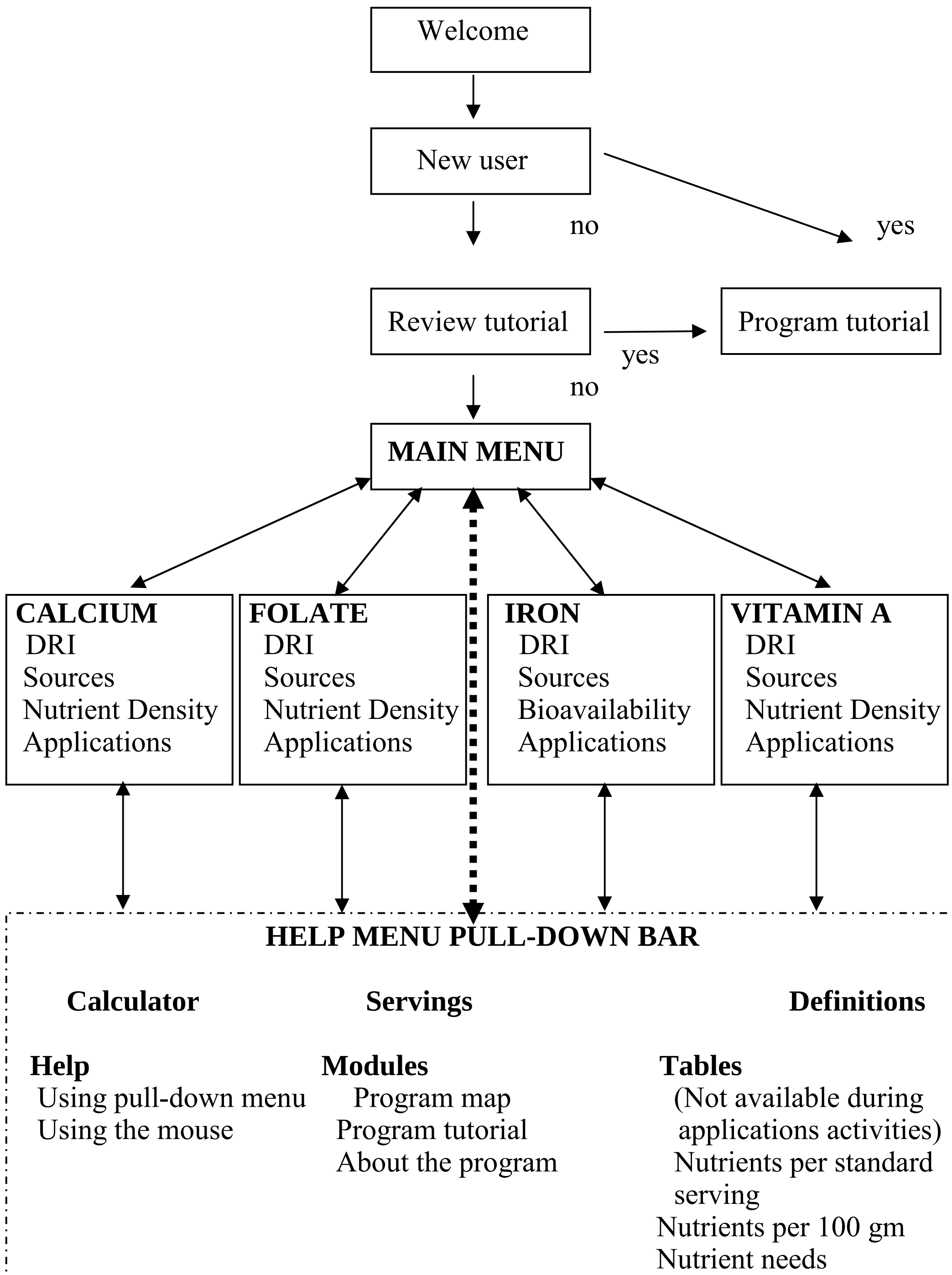

Figure 4 Interactive multimedia program flow diagram

providing at least 5% of the DRI were included. The program was planned for modules to be completed over several weeks, not at a single computer session. However, all 4 nutrient modules could be completed at 1 longer session, and it is likely some subjects chose this option. Each nutrient module was designed so it could be used independently from other modules, and each section within a module also could be reviewed separately. This design allowed both user learning needs and time schedule to be met. The modules were created and programmed by the researchers with limited assistance from paid consultants.

Formative testing of the program was done throughout development of the folate prototype sections. To assure users would be able to identify most of the food graphics used, college students in a communications course at another university were shown pictures of foods and asked to identify them. Introductory nutrition classes at The University of Texas periodically tested the multimedia program as it progressed. Feedback forms were developed to elicit comments on ease of use and reactions to the program (Appendix F). Graduate students taking courses in instructional systems design or in multimedia design also provided feedback on suitability of prototype folate module sections.

COMPUTER SYSTEM

Hardware system requirements for running the program were: 24 Megabyte RAM, 32 bit color, Pentium level processor for PCs, and at least a 68040 processor for Macintosh computers, a CD-ROM drive, and speakers.

Headphones were recommended for use in a computer laboratory setting. Windows 95 or equivalent operating software system also was required. The program was distributed in a packaged version, which allowed the user to run the program without Authorware software.

INSTRUMENTS

Since no instruments were available to assess knowledge, attitude, and self-efficacy specific to material presented in the *SmartBytes* program, a new instrument was developed. The instrument was pilot tested and evaluated for reliability and content validity. A feedback questionnaire also was designed to elicit comments about the program and its use.

Cognitive items: For the pre-/post-intervention assessment instruments, multiple choice questions were generated using the established objectives. Knowledge items were reviewed for content validity by 3 professors in nutrition and 3 registered dietitians. Items were pilot tested and revised.

Pilot versions of the tests were administered as described in the needs assessment section. The test for introductory nutrition students included 32 multiple choice questions; the test for advanced students used the same 32 questions plus an additional 8 multiple choice questions. All questions offered 5 answer options; questions were grouped by the nutrient. A matrix, which may be found in Appendix G, assured that the cognitive questions measured knowledge, application, and analysis levels. Cognitive items are classified according to cognitive domain categories (73) and presented in Table 21 in Appendix G. Completed tests from the needs assessment were scanned and scored at the Measurement and Evaluation Center at The University of Texas. Results for individual items and the instruments as a whole were evaluated for Cronbach alpha (α), difficulty, discrimination, frequency, and descriptive statistics. Since the optimal index of difficulty for questions with 5 answer choices was calculated at 0.6 (74), items with difficulty index values of less than 0.6 or greater than 0.9 were evaluated for content and clarity; items with coefficient of correlation index discrimination values of less than 0.3 (74,75) also were reassessed. Eight items were deleted from the test, and the remaining 24 questions common to both introductory and advanced tests were revised and tested for internal reliability and test-retest repeatability by introductory nutrition students during the summer of 1998, and during the fall of 1998 by undergraduate students in applied learning and development or textile and apparel classes. The additional questions for advanced students were revised, yielding 10 questions that asked students to select the meal supplying the largest amount of 2 or more specified nutrients; these 10 questions were pilot tested with advanced nutrition students at The University of Texas during the fall of 1998.

Internal reliability of multiple choice knowledge instruments was assessed using Cronbach α (42,50,62), or Kuder-Richardson 20 (KR-20), a specific type of Cronbach α used with dichotomous data (26,41,55,63,64). Calculated from both pre- and posttests, the KR-20 alphas for all knowledge items on the final test versions were 0.57 for introductory and 0.63 for advanced instruments. Although a KR-20 or Cronbach α coefficient of at least 0.7 is desirable, KR-20 α values of 0.60 to 0.93 (55,63,64) and Cronbach α coefficients of 0.50 to 0.79 (49,50,62,76) have been reported for multiple choice tests of nutrition knowledge. Knowledge items are numbers 24-47 on introductory pre-intervention, 24-48 on introductory post-intervention instruments, and 27-51 on the advanced pre-intervention and 27-52 on advanced post-intervention instruments (Appendix D). An extra question that was not scored was added to the end of the post-intervention cognitive items to provide additional differentiation of pre-intervention from post-intervention forms.

Attitude items: Attitudes or beliefs, and self-efficacy were assessed with 5-point Likert-type statements. Fifteen attitude statements were adapted from *Eating in America Today* (77) to assess beliefs and attitudes toward consumption of a diet to promote good health and food sources of the nutrients in the program. Content experts at The University of Texas also reviewed the attitude statements for validity.

Students were asked to select answers from "strongly agree," "agree," "neutral," "disagree," and "strongly disagree"; nutrient-specific questions were interspersed with general questions about diet and food groups. Attitude statements were tested for repeatability and reliability with introductory nutrition, textiles and apparel, and applied learning and development students during the summer and fall of 1998. Two items were reworded for the final instrument. Cronbach alphas for all attitude items, calculated from the final pre- and post-intervention instruments, were 0.43 and 0.31 for introductory and advanced instruments, respectively. For attitude items, an α of 0.7 is acceptable, yet alphas ranging from 0.45 to 0.9 regarding computer use and learning, psychosocial scales, and food behavior or selection have been reported (33,34,50,63). Possible reasons for the low internal reliability coefficients may include the relatively small number of items, wording or interpretation of items, specific nutrient addressed by items, or individual differences in subject responses. The attitude statements are the first 15 items on the pre-/post-intervention instruments in Appendix D.

Self-efficacy items: Likert-type questions often are used to assess self-efficacy (33,34,38,42,63,64). As described for the attitude instrument, students were asked to mark Likert-type self-efficacy statements with 5 responses from "strongly agree" to "strongly disagree". Introductory students rated 10 statements regarding their ability to identify foods high in the 4 nutrients; advanced students rated their ability to select meals, evaluate daily intake, and suggest foods that will help meet the DRI for the 4 nutrients. Items were grouped by task, with the easiest task first, as judged by the investigators. Within each task, items for each nutrient were placed in random order. The Cronbach α for all self-efficacy items calculated from pre- and post-intervention instruments was 0.89 for both the introductory and advanced instruments. As for knowledge and attitude, an α of 0.70 is acceptable; alphas for self-efficacy scores have ranged from 0.78 to 0.87 (33,34,38,42,63). The self-efficacy statements are items 16-23 on the introductory instruments and 16-27 on the advanced instruments in Appendix D.

Final instrument: All evaluation items were combined into 1 test instrument. Demographic information and instructions were included at the beginning of the instrument, before any questions or statements; name or identification number, sex, birthday, years of education completed, social security number, and nutrition major/non-major code, were requested but optional. This information was used to match pre-/post-intervention data and for additional data analysis. To prevent possible bias from perceived performance on knowledge questions, attitude and self-efficacy items were placed at the beginning of the instrument. Pre-intervention and post-intervention knowledge, attitude, and self-efficacy items were identical; titles and test codes were changed for the post-intervention. Cronbach alphas for the total instruments, calculated from pre-and post-intervention instruments, were 0.80 for the introductory instrument, and 0.77 for the advanced instrument. Reported Cronbach alphas for instruments with multiple components, such as knowledge and attitude, are 0.67 to 0.87 (49,76). Copies of the final introductory and advanced evaluation instruments are provided in Appendix D.

Program Evaluation Instrument: Program evaluation forms were distributed with the post-intervention instrument to subjects completing the multimedia program. Program users were asked to select responses from 23 5-point Likert-type statements of "very helpful" to "not helpful", rank 4 instructional methods, and estimate time spent on each of the 4 nutrient modules. Questions addressed the helpfulness of the individual nutrient modules and sections common to the modules, time spent on individual nutrient modules, instructional method preferences, and other functional aspects of the program, such as instructions and activities. Three open-ended response questions elicited input regarding what users learned, what they would have liked to learn, and additional comments. Written responses to feedback questions were compiled and reviewed. The program evaluation forms are in Appendix E.

NUTRIENT DATABASES

The USDA food composition database (78) was used for development of nutrient tables and calculations in *SmartBytes* and knowledge instruments. Current food labels provided information for individual products missing from the database. Diet recalls were analyzed using Food Works (79).

DIET RECALL

Food behaviors were assessed using 1-day food records. Methods for collecting dietary intake data of college-aged young adults have include food frequencies (8,23,30,39,41,80-83) food records (24,25,45,71,84,85), and diet recalls (6,7,26,28,86). For free-living situations, there is no ideal method for obtaining food intake data (87,88). When compared to observed intakes, Karvetti and Knuts (89) concluded food records to be a valid method for estimating food intakes of groups. In addition to being an acceptable method, collecting and analyzing individual 1- to 3-day food records is already part of some introductory nutrition curricula, thus fewer additional activities were required of subjects for this study.

Food records were returned to the investigators on floppy diskettes provided for the test sites; subjects recorded food records using food analysis programs for the specific site. Some sites provided written records; these records were entered into Food Works (79) by a single researcher. To enhance consistency, eventually all records were entered into Food Works by the same investigator as a single version for final analysis.

The *Food Guide Pyramid* (3) recommendations include total energy intakes of 1600 to 2000 kilocalories (kcal) for females and 2200 to 2800 kcals for males; energy intakes reported from intake surveys (6,-8,24,25,26) ranged from 1591 to 2217 kcal for females and 2740 to 3097 kcal for males. To reduce inaccuracies of reported energy intakes that are too low or too high (90), the pre-intervention and post-intervention records for each subject that averaged less than 1300 kcal or more than 5500 kcal for males or less than 1000 kcal or more than 4000 kcal for females were deleted from the data. Identical pre- and post-intervention intakes for individuals were considered copied and disregarded. The Food Works database was corrected for several food items that originally did not include values for calcium; records containing these items were re-analyzed.

DATA ANALYSIS

Scantron answer sheets for pre-/post-interventions were read by optical scanner at the University of Texas Measurement and Evaluation Center. Knowledge questions were scored 1 point per correct answer. Attitude, self-efficacy, and feedback items were scanned and scores of 1-5 assigned. Results were reported electronically; then the raw data was converted to Statistical Package for the Social Sciences (SPSS) (91) files. Raw data and SPSS files were reviewed for accuracy by the researchers and assistants. Because of errors in the pretests, questions 34 and 46 were omitted on the introductory tests and question 34 was omitted on advanced tests; scores were recomputed accordingly. Scoring was reversed for attitude items 1, 4, 5, 6, 11, 12, and 13 and for self-efficacy items "strongly agree" was scored as 5. To facilitate comparison with nutrition education literature, program evaluation rankings for instructional methods and helpfulness of modules also were scored with the most desirable answers scored as 5. Written comments were recorded and tallied by hand. SPSS was used for data analysis. Independent Student t-tests were used to compare demographics, mean total knowledge, attitude and self-efficacy scores, mean change in knowledge, attitude, and self-efficacy scores, time on task, mean nutrient intakes, and change in nutrient intakes between instructional groups; except for intake and self-efficacy measures, the same variables listed, also were compared between introductory and advanced groups. Pre- and post-intervention knowledge, attitude, self-efficacy scores and intake measures were evaluated by paired t-tests within instructional intervention and educational level groups. A p value of $\leq .05$ was considered significant. Pearson correlation coefficients identified relationships between change and demographic variables. Means and frequency distribution of scored answers to feedback questions were determined.

Chapter 4: Results

Traditional curricula (TC) for introductory and advanced nutrition courses were enhanced with interactive multimedia (IMM) modules presenting food composition (food sources) for calcium, folate, iron, and vitamin A. This study assessed the effect of the IMM modules, particularly those on calcium and folate, on the cognition, attitude, and self-efficacy of students enrolled in introductory and advanced nutrition courses in universities across the United States. Among students enrolled in introductory courses, the influence of the IMM modules on food behavior, as measured by 1-day food records evaluated for calcium and folate consumption, also was assessed. Feedback from IMM groups regarding use of the IMM modules and instructional method preferences was collected and reviewed.

Sixty-nine percent of introductory students and 85% of advanced students participating in the respective nutrition classes completed both pre- and post-intervention instruments. For introductory and advanced TC and IMM groups, mean total cognitive, total attitude, and total self-efficacy scores did not differ between those subjects providing pre- and post-intervention paired data and the total subject population that included both paired and unpaired pre- and post-intervention data. Therefore, unless stated differently, results for the paired data only are reported in this document. In addition, mean pre- and post-intervention performance for individual test sites are presented in Appendix H. Although some site differences are noted, no consistent pattern was identified by location. Therefore, unless otherwise stated, results from individual testing sites will not be discussed in this paper.

SUBJECT CHARACTERISTICS

The numbers of introductory and advanced students providing paired data from TC and IMM groups and frequency of demographic characteristics by test location are shown in Table 5. Approximately 70%-90% of introductory students provided information for the various characteristics. The majority of all introductory nutrition students providing demographic information were female (79%); only 21% of the students in the introductory classes were nutrition majors. Mean ages reported for introductory students were 20.2 ± 4.4 years for the TC group and 21.0 ± 6.4 years for the IMM group; mean years of education were 14.3 ± 1.1 and 14.5 ± 1.1 for TC and IMM groups, respectively. Frequencies of demographic characteristics for introductory students by location may be found in Table 22 in Appendix H.

Among advanced students, about 67% and 95% of TC and IMM groups, respectively, supplied demographic information. Like introductory students, advanced students providing information also were predominantly female (88%); however, unlike introductory students, 95% of the advanced students were nutrition majors. Mean ages were 22.6 ± 2.8 and 24.1 ± 5.7 years for TC and IMM groups, respectively; mean years of education were 15.9 ± 0.2 for advanced

Table 5 Number of subjects and frequencies of selected demographic characteristics of subjects enrolled in introductory and advanced nutrition classes

Location/Group		**Total**	**Gender**		**Major**		**Age (years)**			**Years education**					
			Male	**Female**	**Nutrition**	**Other**	**<20**	**20-24**	**>24**	**<13**	**13**	**14**	**15**	**16**	**>16**
		n	n	n	n	n	n	n	n	n	n	n	n	n	n
Introductory	TC[a]	210	37[b]	166	21	152	114	78	8	3	27	41	25	20	-
	IMM	208	40	131	55	138	86	77	10	6	22	57	51	39	-
Subotal		**418**	**77**	**297**	**76**	**290**	**200**	**155**	**18**	**9**	**49**	**98**	**76**	**59**	**-**
Advanced	TC	60	3	50	50	3	-	45	6	-	-	-	2	34	-
	IMM	122	17	103	114	6	-	92	28	-	-	-	30	53	3
Subotal		182	20	153	164	9	-	137	34	-	-	-	32	87	3
Total		**600**	**97**	**450**	**240**	**299**	**200**	**292**	**52**	**9**	**49**	**98**	**108**	**146**	**3**

[a] Traditional curriculum (TC), IMM enhanced (IMM)
[b] Numbers for subsets of characteristics may not equal total number of subjects because some subjects omitted information

TC students and 15.7 ± 0.7 for the corresponding IMM group. The frequency data of demographic characteristics for advanced students by location are provided in Table 23 in Appendix H.

COGNITIVE SCORES

Both introductory and advanced students completed the same 24-item multiple choice cognitive test consisting of 15 knowledge and 9 application items, with 6 items related to each of the 4 target nutrients. Most of the 15 knowledge items required familiarity with the nutrient content of given foods to determine the best answer. The 9 application items addressed nutrient density, bioavailability, and comparisons of servings of various foods for nutrient content. Unfortunately, a clerical error on the pretests necessitated omitting a cognitive item pertaining to iron from analysis of both introductory and advanced pre- and posttests. Another error required deletion of 2 application items regarding calcium from the introductory instruments only. Introductory cognitive test scores reflected performance on the remaining 21 items, 14 from the knowledge domain and 7 from application. Cognitive test scores for advanced students were determined from 33 items: the 14 knowledge and 9 application items described previously, plus an additional 10 analysis items that required assessment of nutrient content of food records or meals. Comparisons of change in cognitive scores between introductory and advanced student groups were based on the 21 items common to both instruments. Test instruments are found in Appendix D.

Cognitive items are numbers 24-47 on the introductory instrument and numbers 28-61 on the advanced instrument.

Table 6 Mean change in cognitive total scores and subset scores for students enrolled in introductory nutrition classes

Test items	Change in cognitive scores		
	TC[a]	IMM	p[b]
	Mean ± standard deviation		
21 Cognitive items total score	1.3±3.1	2.4±3.6	.001
14 Knowledge items	0.8±2.4	1.5±2.9	.009
7 Application items	0.6±1.5	1.0±1.6	.006
4 Calcium items[c]	0.1±0.9	0.4±1.0	.003
6 Folate items	0.2±1.5	0.6±1.6	.006

[a] Traditional curriculum (TC), n=210; IMM enhanced curriculum (IMM), n=208
[b] Independent t-test values
[c] Cognitive test items pertaining to calcium or folate

Introductory cognitive scores: Change in cognitive score data are reported in this chapter; mean test scores may be found in Appendix H. As shown in Table 6, means for change in cognitive scores for the 21-item total instrument and for the various subsets differed significantly between introductory groups by the instructional method. The mean improvement in total cognitive score for the IMM group was almost twice that of the TC group (p=.001). Improvement on knowledge items for the IMM group was almost 2 times the improvement seen in the TC group (p=.009). The smallest difference observed between the 2 groups was for application scores where the gain for the IMM group was 167% the increase for the TC group (p=.006). When the changes in cognition regarding the individual nutrients were examined, mean change score for the IMM group for calcium was 4 times that of the minimal change in the TC group (p=.003). For folate items, the IMM group mean gain score was 3 times that of the change for the TC group (p=.006). Mean cognitive pre- and posttest total and subset scores are provided in Table 24 in Appendix H. Mean cognitive total pre- and posttest scores for each test site are shown in Table 25 in Appendix H.

Table 7 Mean change in cognitive total scores and subset scores for students enrolled in advanced nutrition classes

Test items	**Change in cognitive scores**		
	TC[a]	**IMM**	**p[b]**
	Mean ± standard deviation		
	Change in scores		
33 Cognitive items total score[c]	1.1±3.1	4.4±4.0	<.001
14 Knowledge items	0.7±1.8	2.3±2.5	<.001
9 Application items	0.3±1.5	1.2±1.7	.001
10 Analysis items[d]	0.1±1.7	0.8±1.8	.012
6 Calcium items[e]	0.2±1.1	0.7±1.3	.022
6 Folate items	0.0±1.4	0.9±1.6	<.001

[a] Traditional curriculum (TC), n=60; IMM enhanced curriculum (IMM), n=122
[b] Independent t-test values
[c] 33 combined items: 14 knowledge, 9 application, and 10 analysis questions
[d] 10 analysis of diet histories and selection of meals by nutrient content items
[e] Cognitive test items pertaining to calcium or folate

Advanced cognitive scores: Mean changes in the total cognitive scores and subsets for advanced students are shown in Table 7. As observed with introductory students, mean change in scores differed significantly between the traditional and the IMM enhanced curriculum groups. The mean increase in total cognitive scores for the IMM group was 4 times the mean increase for the TC group (p<.001). For the various subset scores, mean gain scores for the IMM group were 3 to 8 times larger than those for the TC group. Mean changes for the IMM group were 3- and 4-fold greater than the increases in TC group on knowledge items (p<.001) and on application items (p=.001), respectively. The mean gain in analysis items for the IMM group was 8 times the gain for the TC group (p=.012). For the calcium item subsets, the IMM group mean score improved 350% more than the TC group (p=.022). On the folate items, essentially no change was observed in the TC group; thus the mean gain of almost 0.9, or essentially 1 item, by the IMM group differed significantly from that of the TC subjects (p<.001). The differences in TC and IMM mean change scores suggest the intervention had a positive effect on cognitive knowledge among students in both introductory and advanced classes. However, mean total cognitive post-intervention scores for IMM groups indicated that on the average only 45%, or 13 of the 21 items, for introductory and just 52%, or 17 of the 33 items, for advanced students were correctly answered. Greater gains are needed in order to validate the educational approach. Factors that may have influenced this disappointing performance are discussed in the next chapter. Mean cognitive total and subset scores for advanced TC and IMM groups are given in Table 26 in Appendix H. Mean cognitive total pre- and post-intervention scores for advanced students by location are presented in Table 27 in Appendix H.

Comparison of introductory and advanced cognitive scores: Gain scores for the identical 21-item cognitive total and subsets for introductory and advanced students are shown in Table 8. Mean gain scores for cognitive total and knowledge items differed significantly between introductory and advanced levels for those in IMM enhanced group (p=.041 and p=.015, respectively); corresponding scores for traditional curricula groups did not differ by education level. Regardless of instructional method, mean cognitive gain in scores for application, calcium, and folate item subsets did not differ significantly by educational levels. Mean cognitive test scores are shown in Table 28 in Appendix H.

Table 8 Mean change in cognitive scores and subset scores for students enrolled in introductory and advanced nutrition classes

Test items	**Change in cognitive scores**		
	Introductory	**Advanced**	**p[a]**
	Mean ± standard deviation		
Traditional curriculum	(n=210)	(n=60)	
21 Cognitive total items[b]	1.3±3.1	0.9±2.1	.230
14 Knowledge items	0.8±2.4	0.7±1.8	.708
7 Application items	0.6±1.5	0.3±1.2	.170
4 Calcium items[c]	0.1±0.9	0.2±0.9	.657
6 Folate items	0.2±1.5	0.0±1.4	.392
IMM enhanced curriculum	(n=208)	(n=122)	
21 Cognitive total items	2.4±3.6	3.2±3.2	.041
14 Knowledge items	1.5±2.9	2.3±2.5	.015
7 Application items	1.0±1.6	1.1±1.5	.785
4 Calcium items	0.4±1.0	0.5±1.1	.335
6 Folate items	0.6±1.6	0.9±1.6	.099

[a] Independent t-test values
[b] 21 item knowledge test: 14 knowledge and 7 application questions
[c] Items pertaining to calcium or folate

As might be expected from prior learning, advanced pre- and posttest scores were greater than the corresponding introductory scores. However, as shown in Table 9, although introductory mean pretest scores were significantly lower than advanced scores (p<.001), the mean total cognitive posttest score of

9.4 ± 3.7 for introductory IMM group mean posttest scores did not differ significantly from the advanced level pretest scores for either the TC or IMM groups (p=.399 and p=.423, respectively). In addition, the mean total cognitive gain score for the introductory IMM group of 2.4 ± 3.6 was significantly greater than the gain score for the advanced TC group of 0.9 ± 2.1 (p<.001). On the average, it appears IMM intervention with the largely non-nutrition-major introductory students accelerated the acquisition of knowledge to that retained by the mostly nutrition major advanced students, as indicated by advanced pretest scores. Gains of advanced students however, enabled them to score significantly higher on the posttest than either of the introductory groups indicating that the base retention from advanced classes was amenable to improvement.

Table 9 Mean cognitive scores of students enrolled in introductory and advanced nutrition classes

	Introductory		**Advanced**	
	TC[a] (n=210)	**IMM** (n=208)	**TC** (n=60)	**IMM** (n=122)
	Mean ± standard deviation			
21 Pretest cognitive items	6.5±2.2[x]	7.0±2.6[x]	9.9±3.3[y]	9.7±2.6[y]
21 Posttest cognitive items	7.8±2.8[w]	9.4±3.7[x]	10.8±3.2[y]	12.9±3.2[z]

[a] Traditional curriculum (TC); interactive multimedia enhanced curriculum (IMM)
[wxyz] Means with different superscript letters are significantly different from all other means in the same row at p≤.05

ATTITUDE SCORES

Both introductory and advanced students completed 15 identical, 5-point Likert-type, pre- and post-intervention attitude items, with a maximum possible score of 75. Answer choices were "Strongly agree" = 1 point, "Agree" = 2 points, "Neutral" = 3 points, "Disagree" = 4 points, and "Strongly disagree" = 5 points; for 7 items, points were reversed to reflect the desirable answers. Items were equally divided between the 4 target nutrients and general food attitudes. Attitude items are numbers 1-15 on the pre and post-intervention instruments for both introductory and advanced students. The instruments may be found in Appendix D.

Table 10 Mean change in attitude scores and subset scores for students enrolled in introductory or advanced nutrition classes

Test items	**Change in attitude scores**		
	TC[a]	**IMM**	**p[b]**
	Mean ± standard deviation		
Introductory	(n=210)	(n-208)	
15 Attitude items total score[c]	1.9±5.2	3.3±5.4	.007
3 Calcium attitude items[d]	0.0±1.9	0.0±2.0	.981
3 Folate attitude items	0.7±1.8	1.2±1.9	.006
Advanced	(n=60)	(n=122)	
15 Attitude items total score	1.5±4.8	2.7±4.9	.124
3 Calcium attitude items	-0.1±1.9	0.0±2.1	.834
3 Folate attitude items	0.7±1.8	1.2±2.2	.132

[a] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[b] Independent t-test values
[c] 15 attitude items for both introductory and advanced students with maximum score of 75
[d] Items pertaining to calcium and folate

Change in mean attitude scores: Mean changes in attitude scores for introductory and advanced students are shown in Table 10. Mean pre-intervention attitude total scores, ranging from 53.2 ± 4.5 for the introductory TC group to 56.8 ± 4.2 for the advanced IMM group, left a potential for about a 15-point gain on the average. Although the mean gain of 3.3 ± 5.4 for the introductory IMM group differed significantly from the increase of 1.9 ± 5.2 for the TC group (p=.007), scores of introductory and advanced students increased by an average of less than 3½ points, regardless of instructional method. The mean change score of 2.7 ± 4.9 for the advanced IMM group did not differ from the change score of 1.5 ± 4.8 for the TC group (p=.124). Subset scores for the 3 calcium items showed no gains by either instructional group or level. As observed for total scores, the mean folate item subset score for the introductory IMM group was significantly greater than that of the TC group (p=.006), but the average folate change scores among the advanced groups did not differ significantly. Mean pre- and post-intervention attitude total and subset scores location are provided in Table 29 in Appendix H. Mean pre- and post-intervention attitude total scores by location are given in Table 30 in Appendix H.

Table 11 Mean change in attitude total score and subset scores for students enrolled in nutrition classes with traditional and IMM[a] enhanced curricula

Test items	**Change in attitude scores** **Introductory**	**Advanced**	**p[b]**
	Mean ± standard deviation		
Traditional curriculum	(n=210)	(n=60)	
15 Attitude items total score[c]	1.9±5.2	1.5±4.8	.654
3 Calcium attitude items[d]	0.0±1.9	-0.1±1.9	.919
3 Folate attitude items	0.7±1.8	0.7±1.8	.936
IMM enhanced curriculum	(n=208)	(n=122)	
15 Attitude items total score	3.3±5.4	2.7±4.9	.363
3 Calcium attitude items	0.0±2.0	0.0±2.1	.883
3 Folate attitude items	1.2±1.9	1.2±2.2	.897

[a] Interactive multimedia = IMM
[b] t-test values
[c] 15 attitude items for both int roductory and advanced students with maximum score of 75
[d] Items pertaining to calcium, folate, or general food attitudes

Comparison of introductory and advanced attitude scores: Table 11 presents comparisons of average changes in attitude scores observed in introductory and advanced students. Mean change scores for total attitude, folate subsets, and calcium subsets did not differ significantly between levels for either instructional intervention. Students experienced no change or a decrease in attitude scores related to calcium, regardless of educational method. Possible reasons for the lack of improvement or decline in attitude scores will be examined in the next chapter.

SELF-EFFICACY SCORES

As described in Chapter 3: Methods, students enrolled in introductory nutrition classes completed 8 self-efficacy items with a total possible score of 40. Students in advanced nutrition classes completed a different set of 12 self-efficacy items with a maximum total score of 60. Parallel items were developed for introductory and advanced levels, but advanced level items addressed tasks of greater difficulty, such as diet history analysis, while introductory level items concerned identification of food sources of the specified nutrient. All items were 5-point Likert-type items with choices from strongly disagree (score of 1) to strongly agree (score of 5). Numbers 16-23 on the introductory test instrument and numbers 16-27 on the advanced test instrument in Appendix D are self-efficacy items.

Introductory self-efficacy scores: Mean change scores for self-efficacy derived from the 8 introductory items and the 12 advanced items are shown in Table 12. Introductory students in IMM enhanced curriculum groups showed significantly larger gains in self-efficacy scores compared to the traditional curriculum group ($p \leq .001$). The self-efficacy total score for the IMM introductory group improved by a mean of 8.5 ± 5.8**,** a gain almost twice as large as that for the TC group of 4.3 ± 5.7 ($p < .001$). The IMM group calcium self-efficacy mean gain score was over 1½ times as large as the mean gain for the TC group ($p = .006$), while the mean gain score for folate items for the IMM group was 260% that of the increase for the TC group ($p < .001$).

Table 12 Mean change in self-efficacy rating scores for students enrolled in introductory and advanced nutrition classes

Test items	**Change in self-efficacy scores** **TC**[a]	**IMM**	**p**[b]
	Mean ± standard deviation		
Introductory	(n=210)	(n=208)	
8 Self-efficacy items	4.3±5.7	8.5±5.8	<.001
2 Calcium self-efficacy items[c]	0.8±1.9	1.3±1.8	.006
2 Folate self-efficacy items	1.0±2.0	2.6±2.1	<.001
Advanced	(n=60)	(n=122)	
12 Self-efficacy items	0.2±7.1	3.1±6.7	.007
3 Calcium self-efficacy items	-0.3±2.0	0.3±1.7	.036
3 Folate self-efficacy items	0.2±2.5	1.1±2.4	.014

[a] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[b] Independent t-test values
[c] Items pertaining to calcium or folate

Advanced self-efficacy scores: Self-efficacy mean total gain scores of the advanced IMM group were more than 15 times the size of those of the TC group (p=.007). The calcium subset of self-efficacy scores increased 0.3 ± 1.7 for the IMM group, while the TC group mean decreased by -0.3 ± 1.7 (p=.036). On the average, gains in self-efficacy scores regarding folate for the IMM group were over 5 times as large as those of the TC group (p=.014).

Comparison of introductory and advanced scores: Mean self-efficacy and total subset scores for introductory and advanced TC and IMM groups are provided in Table 31 in Appendix H. Self-efficacy scores for introductory and advanced scores cannot be compared directly since the items on the 2 instruments were different. It may be notable, that the mean introductory IMM group pre-intervention mean self-efficacy total score improved 37% from 58% (23 of 40) to 79% (32 of 40), while the advanced IMM group score increased just 5% from 75% (45 of 60) to 80% (48 of 60). The introductory TC group mean self-efficacy total rose from 58% to 69% (28 of 40), a gain of 11%; the advanced TC group score was 72% (43 of 60) for both pre- and the post-interventions. Table 32 in Appendix H shows mean total self-efficacy scores by location.

It appears that while introductory students exhibited less self-efficacy at the beginning of the semester, this group gained more self-efficacy than advanced students over the course so that their final scores approached those of the advanced group on a percentage basis. Although self-efficacy gains were larger for introductory groups, the differences between TC and IMM gains were of a greater magnitude for the advanced level. As with cognition, it seems development of self-efficacy for introductory students was accelerated with IMM intervention; for advanced students self-efficacy was enhanced in the IMM group. It should be remembered, that self-efficacy items for introductory students focused on simpler, lower level tasks of identifying nutrient sources, while advanced self-efficacy items tackled more complex tasks such as comparing content of a nutrient in different meals, assessing nutrient content of a food record, and suggesting food choices to increase nutrients for a sample food record.

BEHAVIOR AS INDICATED BY INTAKE OF CALCIUM AND FOLATE

As reported from pre- and post-intervention 1-day food records, intake of calcium and folate was assessed to determine if intervention with the IMM *SmartBytes* program improved food choices as indicated by nutrient intake. Of the introductory nutrition students completing both pre- and post-intervention instruments, one-half provided 1-day pre- and post-intervention diet recalls that met inclusion criteria. To be included, pre- and post-intervention energy intake had to average between 1300 kilocalories (kcal) and 5500 kcal for males or 1000 kcal to 4000 kcal for females. Although young adults may restrict intake to lower levels, it was felt a mean intake minimum of 1000 kcal for females and 1300 for males would provide more accurate data; 14 pairs of food records were eliminated due to low average intakes. In addition, since it could not be established if some subjects might have the same intake daily intake or had simply duplicated their initial food record file, cases where identical food records were submitted for the 2 days were excluded; 2 pairs of food records had identical pre- and post-intervention data and were discarded. Diet records were not requested from advanced students. Mean energy, calcium and folate intakes by gender, for the combined pre- and post-intervention food records, are presented in Table 33 in Appendix H. The mean calcium and folate intakes for females and males are within ranges reported in other studies (6-8,23-26) shown in Table 1 in Chapter 2: Review of Literature.

Table 13 Mean change in calcium and folate intakes for students enrolled in introductory nutrition classes

Nutrient	**TC**[a]	**IMM**	**p**[b]
	Mean ± standard deviation		
Calcium (mg)	-65.9±587.4	+56.6±578.8	.102
Calcium per 1000 kcal	-28.9±249.6	+51.1±276.7	.019
Calcium % DRI[c]	-6.6±58.7	+5.7±57.9	.102
Folate (μg)	+31.5±264.1	+51.7±254.8	.543
Folate per 1000 kcal	+12.3±117.0	+46.3±159.6	.057
Folate % DRI	+7.9±66.0	+12.9±63.7	.543

[a] Traditional curriculum (TC), n=117; IMM enhanced curriculum (IMM), n=128
[b] Independent t-test
[c] Daily reference intake: 1000 mg calcium, 400 μg folate

Mean changes in nutrient consumption for subjects by instructional method may be found in Table 13. The three measures of change in consumption of calcium and folate examined were: change in total intake of the nutrient, change in intake per 1000 kcal, and the change as a percent of the Dietary Reference Intake (DRI). Since changes in calcium and folate per 1000 kcal did not differ by gender for either group, and multiple regression analysis indicated that gender was not correlated with the change in total intakes or change in intake as a percent of the DRI, female and male data for change in calcium and folate consumption were combined.

Calcium intake: Mean change in calcium consumption expressed as mg calcium per 1000 kcal differed significantly between subjects exposed to the IMM versus those in the traditional curricula (p=.021); however, changes in mean mg calcium consumption and mean calcium intakes as a percentage of the DRI did not differ significantly between instructional groups. On the average, those exposed to the IMM increased their intake by 51.1 ± 276.7 mg calcium/1000 kcal while those in the TC classes decreased their consumption by 28.9 ± 249.6 mg calcium/ 1000 kcal over the same time period. For each 1000 kcal consumed, those students in the IMM enhanced curriculum classes increased their consumption of calcium by about 5% of the DRI.

Folate intake: Mean folate intakes increased for all groups with the IMM groups showing greater absolute gains, even though those gains were not significantly different from those of the TC group. However, the IMM group mean gain in μg folate/1000 kcal was almost 4 times that of the TC group. A p value of .057 indicated a strong trend toward a statistically significant difference by educational method for folate consumption per 1000 kcal, also. Mean calcium and folate intakes pre- and post-intervention are presented in Table 34 in Appendix H. The mean intakes of calcium and folate per 1000 kcal by location are provided in Table 35 in Appendix H.

RELATIONSHIPS OF COGNITION, ATTITUDE, SELF-EFFICACY, TIME USING THE SMARTBYTES IMM PROGRAM, AND INTAKE OF CALCIUM AND FOLATE

Pearson correlation analyses provided information on relationships between demographic characteristics, instructional method, changes in total scores for cognition, attitudes, and self-efficacy, and change in behaviors, as represented by intake of calcium and folate per 1000 kcal estimated from 1-day food records.

Relationships for introductory students: For introductory students, gender, major, age, and years education were not correlated with change measures. As shown in Table 14, instructional method was correlated with changes in introductory self-efficacy scores ($r=.340$, $p\leq.01$), change in cognitive scores ($r=.161$, $p\leq.01$), change in attitude ($r=.131$, $p\leq.01$), and change in calcium/1000 kcal ($r=.150$, $p\leq.05$). Change in cognitive scores was correlated with change in self-efficacy scores ($r=.319$, $p\leq.01$), change in attitude scores ($r=.239$, $p\leq.01$), and change in folate/1000 kcal ($r=.132$, $p\leq.05$). In addition to instructional method and change in cognitive scores, change in self-efficacy scores was correlated with change in attitude scores ($r=.331$, $p\leq.01$) and changes in both calcium and folate consumption per 1000 kcal ($r=.193$, $p\leq.01$ and $r=.144$, $p\leq.05$, respectively). Change in attitude scores was correlated with instructional method and changes in cognitive and self- efficacy scores, as previously identified. In addition, change in attitude scores was correlated with change in calcium and folate consumption/1000 kcal (r=.200, p≤.01, and r=.156, p≤.05, respectively). Behaviorally, change in calcium/ 1000 kcal and change in folate/1000 kcal were correlated (r=.348, p≤.01) for the introductory group.

Table 14 Relationships of changes in total cognitive, attitude, and self-efficacy scores, and intakes of calcium and folate of subjects enrolled in introductory nutrition classes

Variable 1	Variable 2	r[a]
Introductory students		
Instructional method	Change in self-efficacy score	.340**
	Change in cognitive score	.161**
	Change in attitude	.131**
	Change in calcium/1000 kcal[c]	.150*
Change in cognitive score	Change in self-efficacy score	.319**
	Change in attitude score	.239**
	Change in folate/1000 kcal	.132*
Change in self-efficacy score	Change in attitude score	.331**
	Change in calcium/1000 kcal	.193**
	Change in folate /1000 kcal	.144*
Change in attitude score	Change in calcium/1000 kcal	.200**
	Change in folate/1000 kcal	.156*
Change in calcium/1000 kcal	Change in folate/1000 kcal	.348**

[a] Pearson product-moment coefficient
[b] Calcium (mg) or folate (µg) per 1000 kilocalorie (kcal); calcium and folate intakes from 1-day food records
*p≤.05, **p≤.01

Relationships for advanced students: Table 15 provides correlation data for advanced students. As with introductory students, instructional method was correlated with change in cognitive scores (r=.380, p≤.01) and change in self-efficacy scores (r=.201, p≤.01). Change in cognitive scores was correlated with change in self- efficacy scores (r=.275, p≤.01), but not change in attitude scores.

Change in self-efficacy scores was correlated with change in attitude scores (r=.281, p≤.01). Thus, for the 3 change scores, only self-efficacy change scores were correlated with both of the other scores. The only demographic variable correlated at either educational level was years of education, which was negatively correlated with change in attitude scores (r=-.228, p≤.05) among advanced students, i.e. increased years of education were associated with smaller or negative changes in attitude scores. For introductory and advanced students, change in self-efficacy was related to change in cognition and attitude scores, but change in cognition and attitudes scores were related only among introductory students.

Table 15 Relationships of changes in cognitive, attitude, and self-efficacy scores of subjects enrolled in advanced nutrition classes

Variable 1	**Variable 2**	**r[a]**
Instructional method	Change in cognitive score	.380**
	Change in self-efficacy score	.201**
Change in cognitive score	Change in self-efficacy score	.275**
Change in self-efficacy score	Change in attitude score	.281**
Years of education	Change in attitude score	-.228*

[a] Pearson product-moment coefficient
*p≤.05, **p≤.01

FEEDBACK ON MODULES

Students in introductory and advanced nutrition classes with the IMM enhanced curriculum were asked to complete a feedback questionnaire after they had completed the *SmartBytes* IMM program. Students were asked how much time they spent on the *SmartBytes* IMM program and individual nutrient modules, how they ranked the 4 instructional methods, and how helpful they found various characteristics of *SmartBytes.*

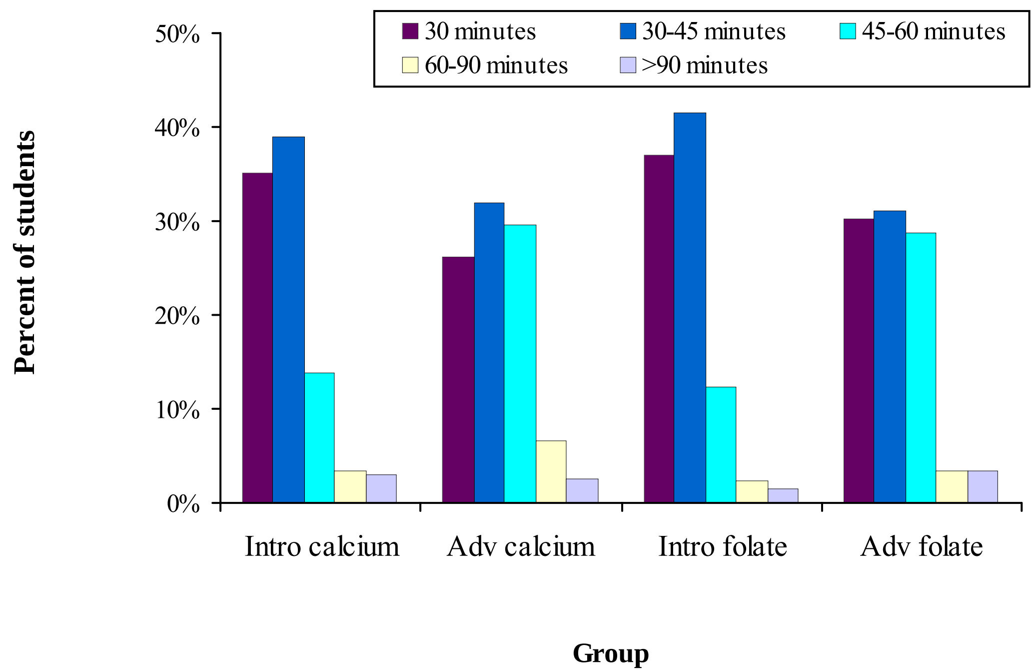

Figure 5 Time spent on calcium and folate IMM modules by percentage of students enrolled in introductory (intro) and advanced (adv) nutrition classes

Time on modules: Students selected from the choices: 1 = less than 30 minutes, 2 = 30-45 minutes, 3 = 45-60 minutes, 4 = 60-90 minutes, and 5 = more than 90 minutes. Estimated time spent on all 4 nutrient modules averaged less than 2 hours for introductory students and about 2 to 3 hours for advanced students (p=.001). As illustrated in Figure 5**,** over 70% of introductory students and 50%

of advanced students spent 45 minutes or less using the Calcium or Folate Modules; only about 5% of introductory and 12% of advanced students spent more than 60 minutes on each of the modules covering calcium and folate. In general, advanced students reported spending more time on task for each module than introductory students. Based on the scale of 1-5 for 15- and 30-minute increments described earlier in this paragraph, means for time spent on the Calcium Module were almost 30 minutes (1.9 ± 1.0) for introductory and 30-45 minutes (2.3 ± 1.1, p=.004) for advanced students; similar times were reported for the folate modules, with mean time ratings of 1.8 ± 0.9 for introductory and just over 30 minutes 2.2 ± 1.0 (p=.003) for advanced students.

Ranking of instructional methods: Students were asked to rank 4 modes of instruction, the class text, lecture, the *SmartBytes* IMM program, and diet analysis activity, such as keeping a 1- to 3-day food record and analyzing it, according to their perceived value of the mode for learning food composition**.** Figure 6 shows how differently introductory and advanced students ranked each instructional method. *SmartBytes* was ranked first by about 40% of advanced students, but first by only 17% (p<0.001) of introductory students; 47% of introductory students ranked lecture first, while about 17% ranked *SmartBytes* first; 21% ranked *SmartBytes* second and 31% ranked it third. Introductory and advanced students also rated text differently, with text ranked second by 32% of introductory students and by 22% of advanced students; 35% of advanced

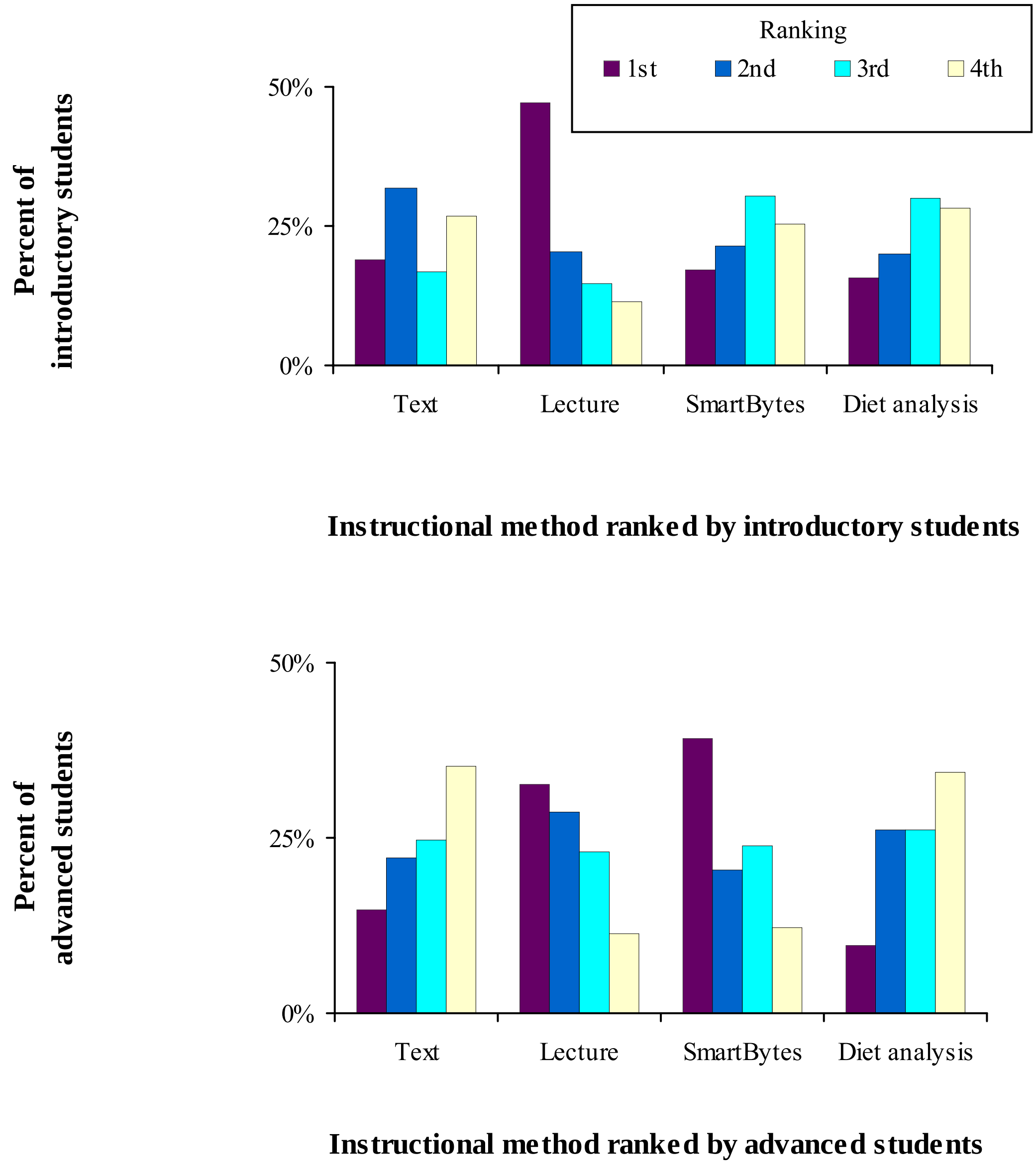

Figure 6 Value of various instructional methods to learning food composition as ranked by students enrolled in introductory and advanced nutrition courses.

students ranked text fourth compared to 27% of introductory students ($p=.033$). Among the 2 educational levels, rankings did not differ significantly for lecture ($p=.100$) or diet analysis assignment ($p=.262$). Females preferred *SmartBytes* more than did the males ($p<.001$).

Perceived usefulness of SmartBytes IMM Module: Five-point Likert-type items were completed to evaluate how helpful *SmartBytes*, individual nutrient modules, and various aspects of the IMM program were to the user. Figure 7 represents the ratings for helpfulness of *SmartBytes* and the Calcium and Folate Modules. The *SmartBytes* IMM program was rated as helpful or very helpful by 80% of introductory students and 84% ($p=.310$) of advanced students; only about 3 to 4% all the students rated the program as not very helpful or not helpful. The Calcium Module was assessed as helpful or very helpful by almost 89% of introductory and 85% ($p=.484$) of advanced students. Similarly, about 85% of introductory student and 84% ($p=.195$) of advanced students reported the Folate Module was helpful or very helpful.

For introductory IMM students, time using *SmartBytes* was correlated with changes in cognition ($r=.357$, $p\leq.010$), attitude ($r=.186$, $p\leq.01$), self-efficacy ($r=.186$, $p\leq.01$), and calcium/1000 kcal ($r=.189$, $p\leq.05$), and folate/1000 kcal ($r=.221$, $p\leq.05$). Time on *SmartBytes* was correlated with change in cognition ($r=.217$, $p\leq.05$) and self-efficacy ($r=.228$, $p\leq.05$) for advanced IMM students, as identified for instructional method. By perceived helpfulness in learning food

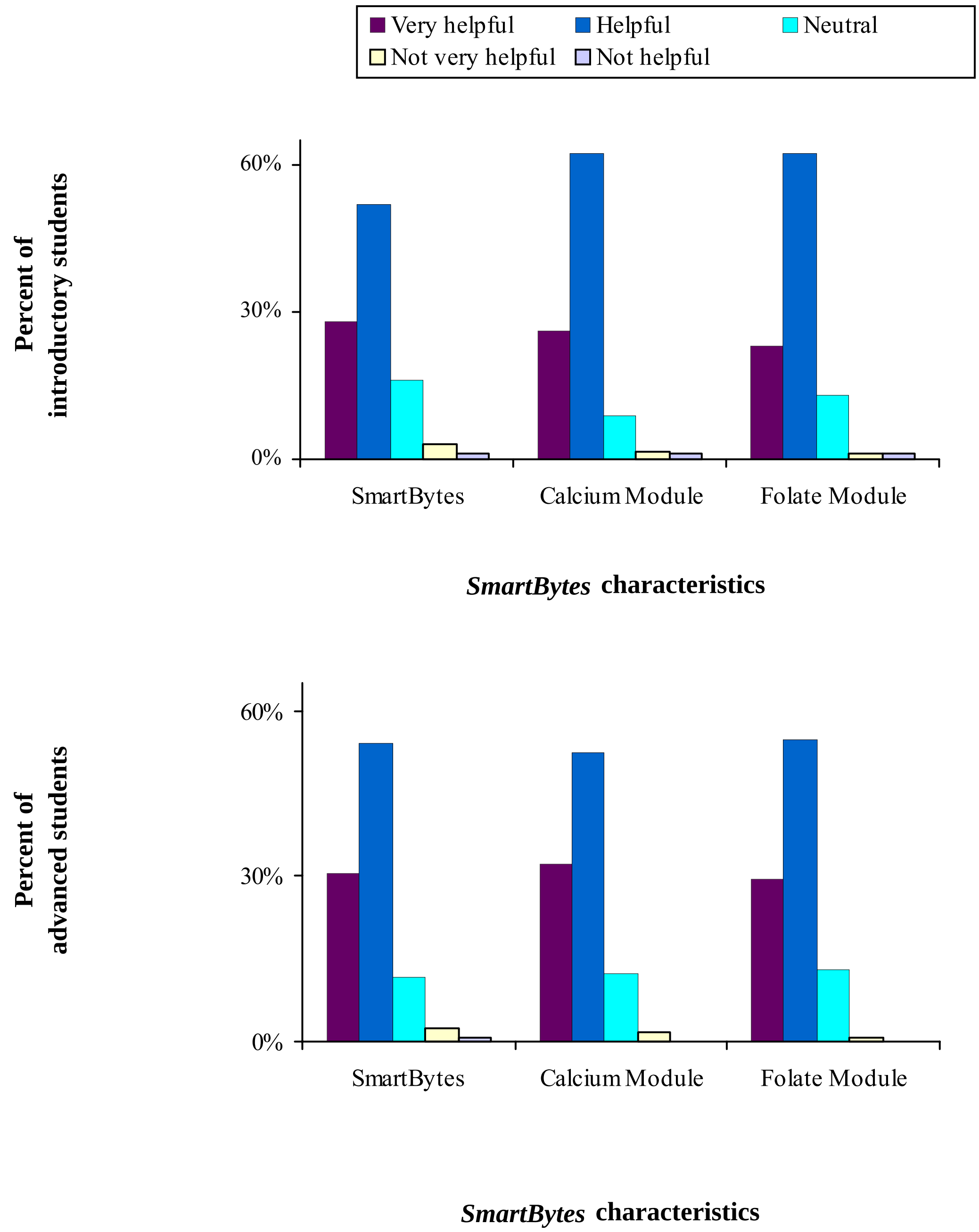

Figure 7 Ratings of perceived help to the user of the SmartBytes multimedia program and individual modules on calcium and folate by percentages of students enrolled in introductory and advanced nutrition courses.

composition compared to lecture, class text, or diet analysis activity, the rank of *SmartBytes,* was correlated with change in cognition ($r=-.180$, $p \leq .05$) and of folate/1000 kcal ($r=.184$, $p \leq .05$) for introductory students, and with change in self-efficacy ($r=.415$, $p \leq .01$) for advanced students. Time spent by introductory students also was correlated with the *SmartBytes* ranking for helpfulness in learning food composition ($r=.183$, $p<.05$), and for general helpfulness of the program ($r=.170$, $p<.05$); rank was correlated with general helpfulness ($r=.313$, $p<.01$). For advanced IMM students, only rank and general helpfulness were correlated ($r=.477$, $p<.01$).

Figures 8 - 10 show students' ratings for selected sections or features of *SmartBytes*. Ratings did not differ significantly by educational level. As depicted in Figure 8, approximately 80% or more of both introductory and advanced students rated the program instructions, sections on nutrient requirements and sources as helpful or very helpful. A trend was noted for the sources section to be rated as more helpful by the advanced as compared to the introductory level ($p=.074$). Figure 9 shows that about 70% or more of all students rated the sections on nutrient density, bioavailability, and analysis of menus as helpful or very helpful. Advanced students also were asked how helpful the program was in improving their ability to analyze diet histories (not shown); over eighty percent responded it was helpful or very helpful. As displayed in Figure 10, about 80% students rated the interactive activities as helpful or very helpful, while at least

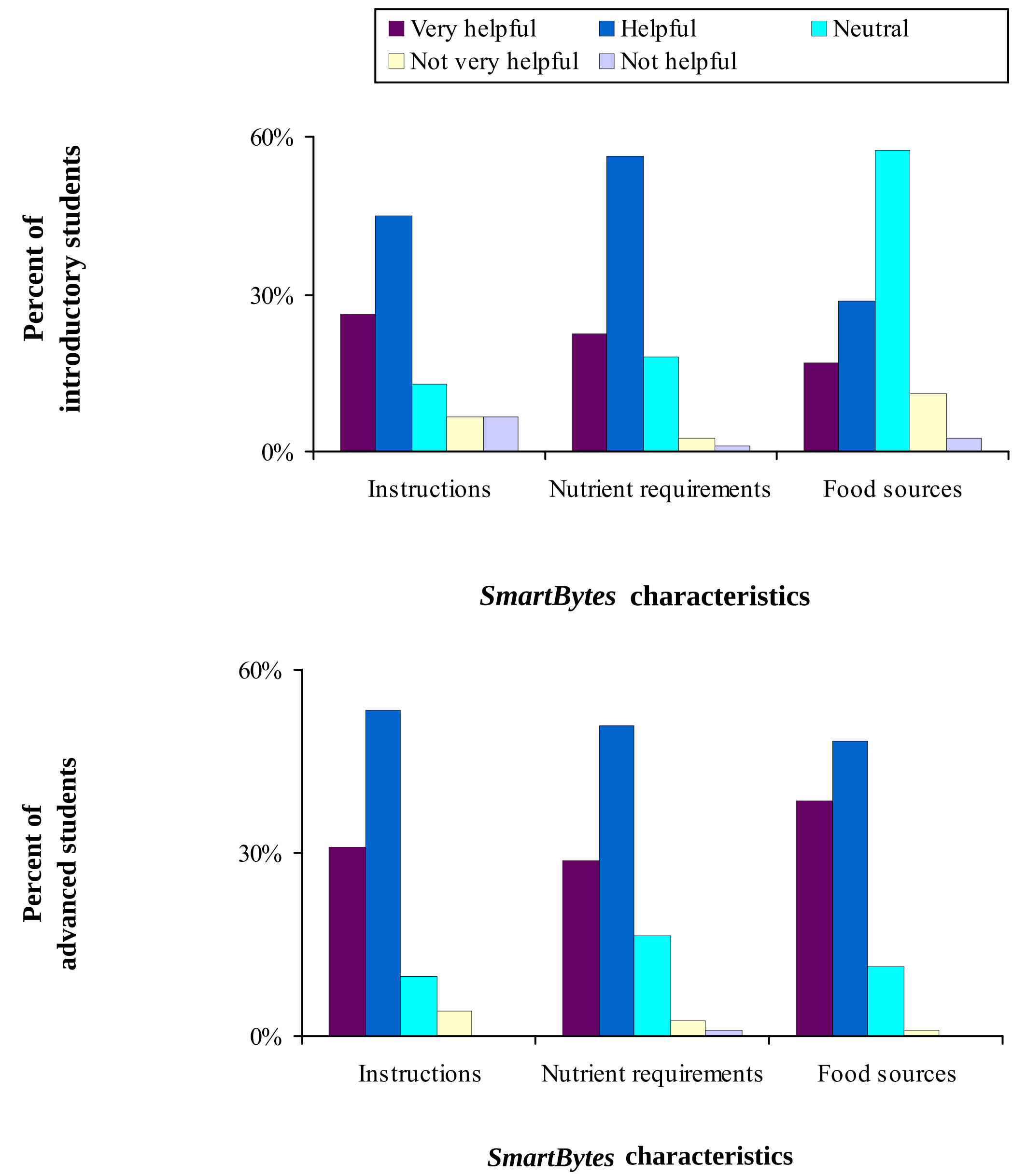

Figure 8 Ratings of perceived help to the user of SmartBytes multimedia program instructions and sections on nutrient density or bioavailability, nutrient requirements, and food sources by percentages of students enrolled in introductory and advanced nutrition courses.

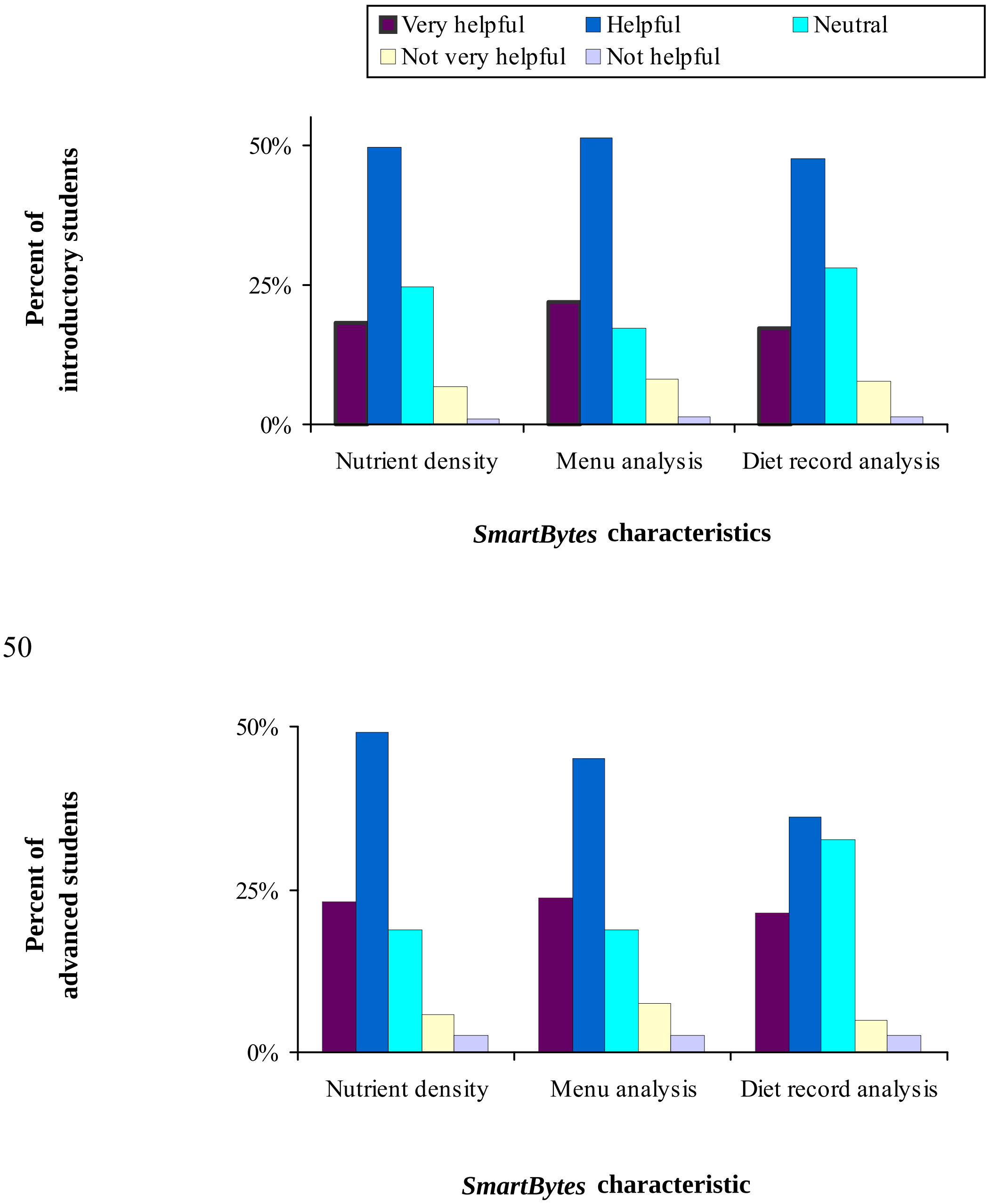

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Figure 9 Ratings of perceived help to the user of SmartBytes multimedia program sections on nutrient density or bioavailability, menu analysis, and diet record analysis by percentages of students enrolled in introductory and advanced nutrition courses.

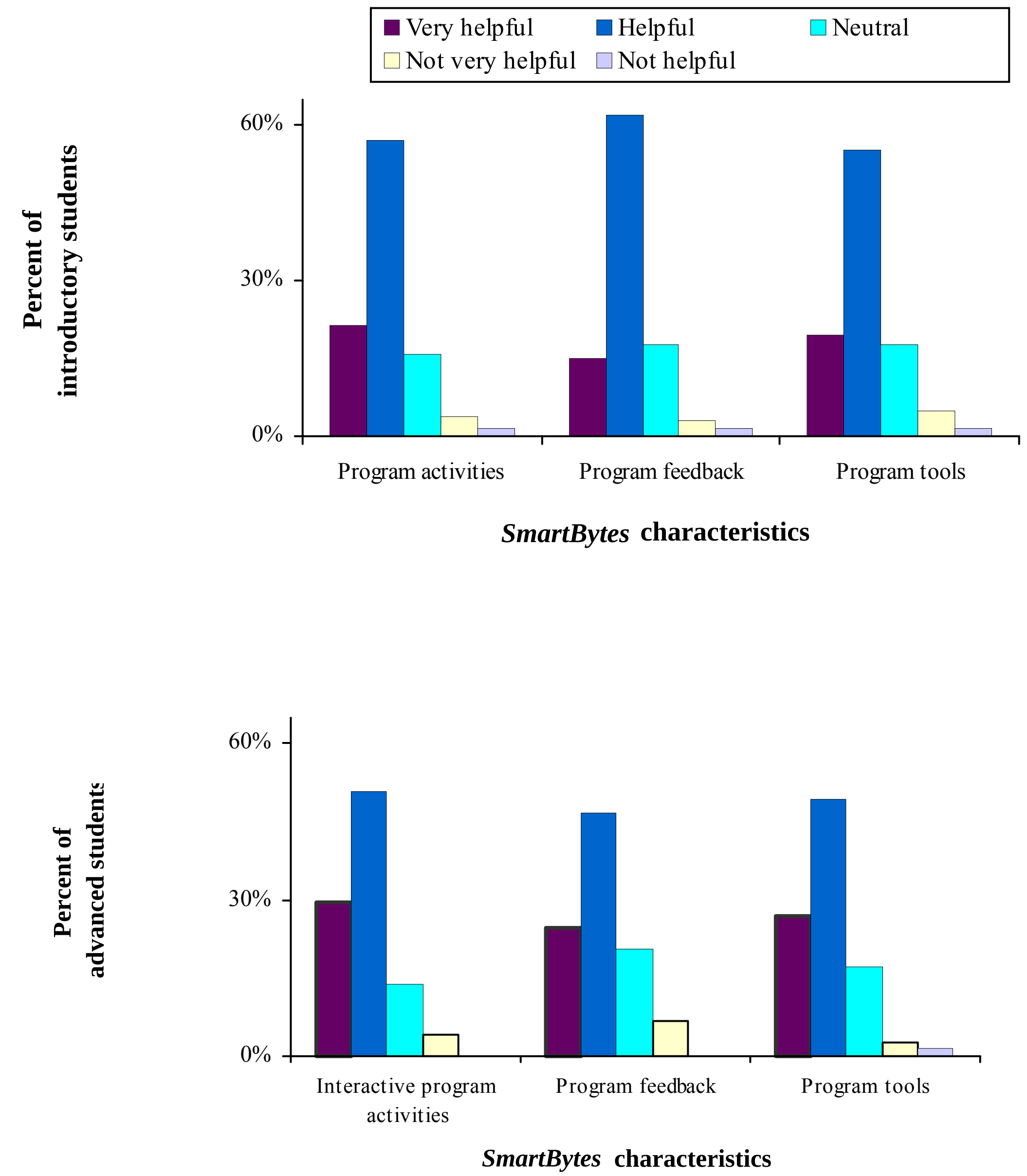

Figure 10 Ratings of perceived help to users of SmartBytes multimedia program activities, program feedback to users, and program tools by percentages of students enrolled in introductory and advanced nutrition courses.

70% found the program feedback provided, and program tools, such as calculator and tables were helpful**.**

Subject comments: Two open-ended feedback questions asked the students to identify an important thing they had learned and something they would like to have learned; a third question simply asked for comments and was intended to identify areas for program improvement. One-hundred-fifty of the IMM introductory students and 88 of the IMM advanced students, for a total of 238, gave written responses to at least 1 of the 3 feedback questions. Most of the responses regarding content of the *SmartBytes* IMM program were positive. Summaries of the most common responses to all 3 questions are provided in Figure 11.

What students learned: The most frequent responses for both introductory (42 responses) and advanced students (52 responses) were that they had learned sources of various nutrients; as a student put it, they were able to "visualize food sources as they relate to each other." Learning the nutrient DRI and serving of foods to meet the DRI were other items mentioned, either singly or in conjunction with food sources. About 14% of respondents reported learning how to select from restaurant menus, or as a student wrote: "The best part is when I had to choose from menus, because I can put that in practice." Additional comments ranged from students being better able to evaluate their own diets to learning definitions.

Responses to "One important thing I learned from *SmartBytes* was:"

Sources of nutrients or nutrient content of specific foods (123 comments)
Dietary Reference Intake or importance of the nutrient (39 comments)
Selecting for nutrients from restaurant menus (32 comments)
Servings of foods (22 comments)
"About" 1 or all of the 4 nutrients (12 comments)

Responses to "One thing I wish I had learned from *SmartBytes* was:"

About other nutrients (40 comments)
Nothing or couldn't think of anything (20 comments)
Related health an diet topics such as how to change diet habits, physical fitness, supplements, vegetarian eating, or shopping (18 comments)
More on 1 or more of the 4 nutrients in *SmartBytes* (15 comments)
Wish they had more time or spent more time (13 comments)
Meal planning to include all the nutrients (11 comments)

Responses to the request for additional comments:

Helpful, useful (24 comments)
Good, excellent, interesting (19 comments)
Enjoyed, liked; found it fast and easy and liked visuals, ease of use, menus, working at own pace, narration (18 comments)

Too much time, long, too much for the class workload, or contained too much information (20 comments)
Repetitive, redundant, monotonous (10 comments)

Figure 11 Comments about the SmartBytes IMM program from students enrolled in introductory and advanced nutrition classes

What students wish they had learned: The second question stimulated a great variety of responses. Almost 25% of those responding would have liked information on other nutrients or more on the 4 nutrients in *SmartBytes*. Twenty students indicated they could not think of anything more they wanted to learn.

Nutrition-related topics they wish they had learned, such as how to change diet habits, physical fitness, facts about and use of supplements, vegetarian eating, and shopping were identified by 18 students. Thirteen students wished they had spent more time on the program or had more time available. Learning to plan meals to meet needs for all 4 nutrients was important to others.

Additional student comments: Most students gave positive or constructive feedback. One astute student summed it up with "*SmartBytes* is just a smart program." Nearly 25% of respondents found *SmartBytes* helpful, good, or enjoyed it. Users found it "...helpful because it reinforced each concept with pictures..." and a student labeled it a "hands on activity good for retention". They liked the menus, working at their own pace, and found narration helpful. One student wrote "I wish I had completed the disk before my test."

The major complaint about the program for 17 students was that it took too much time, especially for the class workload. Ten others found it repetitive, monotonous, or said that it contained too much information. Some students provided constructive criticism regarding how to shorten sections, other expressed impatience with audio slowing the program and a few technical problems during the program. In spite of some of the negative aspects, students still liked the program, writing "They were lengthy but a good teaching tool."

SUMMARY OF RESULTS

The results of pre- and post-intervention assessment demonstrate significantly greater gains in mean cognitive and self-efficacy scores for both introductory and advanced students in IMM enhanced curricula groups compared to the increases in mean scores for students in the corresponding traditional curricula groups. Mean cognitive scores were greater for advanced compared to introductory students, but even post-intervention advanced scores for the IMM group averaged only 52% correct. Change in mean attitude scores differed significantly by instructional method only for introductory students, and did not differ by class level. Analysis of behavior change as measured by pre- and post-intervention 1-day food records for introductory students indicated that only the mean gain in calcium intake/1000 kcal for the IMM group differed significantly from the corresponding change in the TC group; although the change in folate/1000 kcal did not differ significantly (p=.057) between the instructional groups, mean post-intervention intake for the IMM group was significantly larger than that of the TC group while pre-intervention intakes were not different.

For both introductory and advanced students, instructional method was correlated with changes in cognitive and self-efficacy scores, while change scores for self-efficacy were correlated with changes in cognition and attitude scores. Cognition and attitude change scores were correlated for introductory students only. For introductory students, change in folate/1000 kcal was correlated with instructional method and change in cognitive, attitude, and self-efficacy scores; calcium/1000 kcal correlated with all measures except change in attitude score. Change in calcium and folate per 1000/kcal also were correlated with each other. For advanced students, change in attitude scores was negatively correlated with years of education.

Feedback ratings and written comments from students completing the *SmartBytes* IMM program indicated the program was well received. Compared to lecture, text, and diet analysis activities for value to the students in learning food composition, advanced students ranked *SmartBytes* first, while introductory students ranked *SmartBytes* third and lecture first. The majority of students found the program helpful.

Chapter 5: Discussion

This investigation tests the hypothesis that students enrolled in nutrition classes enhanced with interactive multimedia (IMM) curricula on nutrient content of foods will exhibit significantly greater changes in cognition, attitude, self-efficacy, and food selection behaviors related to these topics, when compared to corresponding changes for students enrolled in traditional curricula nutrition courses (TC). Objectives and cognitive test items were developed and a needs assessment completed. Attitude and self-efficacy items were generated and combined with cognitive items for the pre-/post-intervention instruments. An IMM program, *SmartBytes*, was developed which presented sources, Dietary Reference Intake (DRI) information, and nutrient density or bioavailability considerations, for 4 nutrients: calcium, folate, iron, and vitamin A. An additional section in each module provided practice identifying and selecting foods and meals according to content of the target nutrient. Students enrolled in introductory and advanced nutrition classes at selected universities located throughout the United States served as subjects for this study. Students enrolled in classes with traditional nutrition education curricula (TC) served as control subjects, while experimental subjects were students enrolled in classes where they completed IMM enhanced nutrition education curricula (IMM) along with their normal course activities. This paper compares mean change in scores for cognition, attitude, and self-efficacy, particularly related to calcium and folate, from the pre- and post-intervention test instruments by instructional intervention, and between class levels. Changes in consumption of calcium and folate, as estimated from 1-day food records, were assessed for students enrolled in introductory classes.

As hypothesized, cognitive and self-efficacy scores of students enrolled in IMM enhanced curricula showed significantly greater gains than scores for those without IMM enhancement. However, in this study, the mean change in total attitude scores for introductory IMM students only was significantly greater than the mean change for the TC group; changes in mean total attitude scores did not differ significantly for advanced students by educational method. Food selection behaviors for introductory students, as indicated by change in consumption of calcium and folate per 1000 kilocalories (kcal), were enhanced in the IMM compared to the TC classes. As supported by nutrition education literature, change in self-efficacy was correlated with change in cognition and attitude for both class levels. Feedback indicated *SmartBytes* was well received as a learning program by students.

In this chapter, results of this study are compared to similar measures from the nutrition education literature. Implications of changes in scores for cognition, attitude, and self-efficacy, and consumption of calcium and folate are presented. Strengths and limitations of the *SmartBytes* IMM program and the study are examined. Potential areas for improvement for future research and difficulties encountered also are presented.

Table 16 Mean posttest cognitive total scores and change in scores as percent correct for students enrolled in introductory and advanced nutrition classes

Test items	**Knowledge scores**		
	TC[a]	**IMM**	**p**[b]
	Percentage correct		
Introductory	(n=210)	(n=208)	
21 Posttest cognitive items	37±13[c]	45±18	<.001
Change in 21 cognitive items	6±15	11±17	.001
Advanced	(n=60)	(n=122)	
33 Posttest cognitive items[d]	42±11	52±12	<.001
Change in 33 cognitive items	3±9	13±12	<.001
21 Posttest cognitive items	51±15	61±18	<.001
Change in 21 cognitive items	4±10	15±15	<.001

[a] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[b] Independent t-test values
[c] Mean ± standard deviation
[d] 21 items identical to introductory

COGNITION

Table 16 provides cognitive total scores and changes in scores as percentages. Mean percent subset scores are given in Table 36 in Appendix I. The mean increase in the 21-item cognitive total score of 11% ± 17% for the introductory IMM group was significantly greater than the 6% ± 15% increase or the TC group (p=.001); scores for the identical 21 items grew 15% ± 15% for the advanced IMM group, compared to a gain of 4% ± 10% for the advanced TC group (p<.001). For the 33 cognitive items on the advanced instrument, the 13% ± 12% improvement in advanced IMM scores was greater than the 3% ± 9%

gain for the TC group ($p<.001$). The significantly larger improvements among the IMM subjects indicate that enhancement of traditional curricula with *SmartBytes* increased learning at both levels. However, it was disappointing that the means for all groups, ranging from 37% to 52%, would have earned a failing grade in most settings. In addition, these gains and posttest scores are smaller than those reported in other nutrition education studies involving medical students, dietetics students, and students enrolled in nutrition and educational psychology classes (46,55,57,63,65).

When completion of an IMM module on nutritional links to cancer was required as part of a nutrition course for 156 medical students, Kohlmeier et al (65) reported that the mean knowledge score for 20 multiple choice items increased 64% from 22% to 86% ($p<.0001$); follow-up at 3 months revealed a mean score of 61%. In a second study described by Kumar et al (46), 92 educational psychology students participated in an evaluation of an IMM program *Diet, Nutrition and Cancer Prevention*, to fulfill course enrichment requirements. Performance on a 50-item fill-in-the-blank instrument at the pretest, posttest, and delayed posttest, assessed knowledge of subjects in the 3 intervention groups: IMM program, and non-interactive computer-assisted instruction (CAI), or paper text versions presenting the same material as the IMM program. The mean gain in knowledge scores from the pre- to the posttest of 41% for the IMM group differed significantly from the mean change score of 36% ($p=.008$) for the paper text group; the mean change of 37% for the non-interactive CAI group did not differ significantly from the IMM or text group. The mean change from pretest to delayed posttest of 33% for the IMM group was significantly greater than the mean changes of 21% and 22% for the CAI and text groups, respectively ($p<.001$), however.

Mean cognitive gains seen in the current study are closer to the -2% to 9% changes exhibited by 37 students enrolled in an introductory food and nutrition class reported by Ries and Granell (62). They assessed knowledge by pre- and post-intervention performance on a 48-item multiple choice test following completion of an IMM module on vegetarianism, lecture/discussion on vegetarianism, or lecture/discussion on another topic. Scores changed from 68% to 77% (+9%) for the IMM group, from 67% to 73% (+6%) for the vegetarian lecture group, and from 73% to 71% (-2%) for those experiencing lecture/discussion on another topic. No significant differences were observed between pre- and posttest scores, nor between intervention groups for either pretest scores or posttest scores. The authors suggested the small sample size of 11 to 13 per group and level of initial knowledge may have reduced the likelihood of significant changes. In the study described in this dissertation, the larger sample size resulted in statistical significance in the presence of small average changes ranging from 3% in some subsets to 13% on the total instrument.

Perhaps more relevant to the results of the current study, Ries and Granell (62) stated that subjects were "least knowledgeable about nutrients of concern for various vegetarian diet types and good food sources of theses nutrients." This observation speaks to the need for education on nutrient composition of food and may help explain the dismal mean pre- and post-intervention cognitive scores for the current study, since items addressed only nutrient sources. Fortunately, as shown in Table 17 that delineates ranges of percentage scores for cognitive totals and subsets, scores for some of the students in the present study demonstrated acceptable to exemplary performances.

Table 17 Ranges for mean posttest cognitive total scores and subsets as percentages correct for students enrolled in introductory and advanced nutrition classes

	TC[a]		IMM	
Test items	**Mean**	**Range**	**Mean**	**Range**
Introductory	(n=210)		(n=208)	
21 Cognitive items[b]	37	5-76	45	5-90
14 Knowledge items	37	7-100	44	7-100
7 Application items	37	0-100	46	0-100
Advanced	(n=60)		(n=122)	
33 Cognitive items	42	21-70	52	24-81
14 Knowledge items	51	21-86	61	21-93
9 Application items	44	0-78	53	11-67
10 Analysis items	27	0-60	36	8-70
21 Cognitive items[d]	51	14-81	61	24-90
7 Application items[d]	53	0-100	63	14-100

[a] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[b] Number and type items
[d] Items identical to introductory items

Ries and Granell (62) also noted students could not apply facts and concepts as well as they could recall them. In the current study, this observation appears true for advanced students. Table 18 provides posttest data assessing

Table 18 Mean cognitive posttest total and subset percent correct scores for students enrolled in introductory and advanced nutrition classes

Test items	**Knowledge scores**	
	TC[a]	**IMM**
	Percent correct	
Introductory	(n=210)	(n=208)
21 Cognitive items	37±14[b]	45±18
14 Knowledge items	37±15	44±19
7 Application items	37±19	46±23
Advanced	(n=60)	(n=122)
33 Cognitive items total	42±11[x]	52±12[x]
14 Knowledge items	51±16[y]	61±18[y]
9 Application items	44±19[x]	53±16[x]
10 Analysis items	27±13[z]	36±14[z]
21 Cognitive items[c]	51±15	62±15
14 Knowledge items	50±15	61±18
7 Application items	53±22	63±18

[a] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[b] Mean ± standard deviation
[c] Identical items to introductory posttest
[xyz] Means with different superscript letters in a column subset are significantly different from the other means within a section at p≤.001 from independent t-test; absence of superscript letters indicates no difference within that section.

cognitive performance by question type. At either educational level, posttest total cognitive 21-item scores, and the 14-item knowledge and 7-item application subsets did not differ significantly. As identified by superscript letters, the mean analysis posttest scores of 27% and 36% for the advanced TC and IMM groups were considerably lower than the 33-item total scores, knowledge, and application subset scores ($p \leq .001$). Mean scores for the 14 knowledge items also differed significantly from 33-item cognitive totals and 9-item application scores for both advanced groups. Total scores and application scores did not differ significantly regardless of educational method. A *SmartBytes* activity in the Application sections did provide practice in identifying the meal with the highest concentration in the nutrient of interest. The means for the analysis subsets suggest either students did not review the particular section, did not learn to identify meals richest in a specified nutrient, or were unable to assess diets for multiple nutrients simultaneously.

Instead of change in performance, some investigators have reported differences in posttest scores between intervention groups to show significantly greater accomplishment with IMM intervention. Byrd-Bredbenner and Bauer (63) evaluated post-intervention knowledge of 159 students enrolled in an introductory nutrition course over different semesters. While the control students attended traditional lectures, for the IMM students, 1 lecture was cancelled per IMM module to allow time to use the 7 IMM modules tested; material covered in the modules was not presented in other lectures for that group. The IMM group mean of 57% for those completing an IMM module on vitamins was significantly greater than the mean of 46% for controls ($p<.05$). For a module on minerals, the mean posttest score of 77% items for IMM group was greater than the mean of 60% for controls ($p<.05$); posttest scores on each of the 5 additional modules for the IMM group were significantly larger ($p<.0001$) than for corresponding means for the controls. Other studies from nutrition education literature have reported scores for IMM intervention programs to be significantly greater ($p<.05$) than non-interactive CAI, CAI enhanced lecture, and lecture (46,55,57). Mean scores assessing retention also were greater for IMM compared to CAI or control groups (46).

Gains for educational psychology and medical students, of 21% to 64% reported by Kumar et al (46) and Kohlmeier et al (65), are about 2 to 6 times the 11% and 13% increases for the IMM groups found in this study. Each of these studies tested subjects at single locations, where at least one of the investigators participated directly in the class from which data were collected. Variations in instructor, class organization, emphasis on food composition, the importance placed on completing the IMM program, administration and timing of the instruments, and attitudes of both preceptors and students at different locations may have contributed to the range of achievement seen in the present study.

Differences in motivation may have contributed to the discrepancy in score changes found in the present study. Major motivators for students may be the value of the effort in terms of grades or interest in the subject. Participation was required for the medical and psychology students in studies previously cited (46,65) and tied to course grades. Completion of *SmartBytes* was not mandatory at most test sites in this study; instead, a few extra credit points were awarded for completing pre- and posttests. Thus, motivation in the cited studies was likely superior to that engendered by bonus points offered in the current study that had the potential of a relatively small impact on course grades. Since the use of the *SmartBytes* program for the IMM groups was not important for course grades, there was little incentive to review the program thoroughly and do well on the posttest. However, the maximum posttest scores for 21 cognitive items of 90% (Table 17) for both advanced and introductory IMM students indicates good performance by some students. Maximum scores for the same 21 items for TC groups were 76% and 81% for introductory and advanced students, respectively. For advanced groups, maximum scores for the 33-item posttest scores were 70% for TC students and 81% for advanced IMM students. Poor performance on the analysis items, where the best scores were 60% and 70% for the TC and IMM groups respectively, was evident in the 33-item total scores.

Removing grades as a motivation to learn the food composition information presented in *SmartBytes* leaves interest in the subject as the potential primary motivator. At the introductory level, the majority of students were not nutrition majors. Their interest in nutrition likely varied from thinking introductory nutrition was an easy class to wanting to improve their own health. However, a number of studies have indicated that eating for good health is not a primary concern for young adults (76,81-85). Psychological, social, and physiological influences all contribute to the interaction of food behaviors

(23,29,31). Various studies have documented that these influences on eating or food selection behaviors of college-aged young adults in addition to health includes: taste, nutrition, price, variety, freshness, appearance, and "keeping quality" of food, convenience or ease of preparation, weight concerns, time for preparation, time for eating, shopping skills, cultural norms, food safety beliefs, and availability of grocery stores and transportation (81-83).

It is not surprising the introductory IMM groups reported spending a significantly shorter mean time of less than 2 hours using *SmartBytes* compared to 2 to 3 hours estimated for the advanced IMM group. Time spent on the modules was correlated with change in cognition, which is illustrated by the significantly greater mean change score for the 21 cognitive items for the advanced IMM students compared to that of introductory IMM students (p=.041). The difference in time spent on *SmartBytes* implies introductory students were less interested in learning the material than advanced students. Even the nutrition majors in introductory nutrition classes may not have realized the importance of, or developed an interest in, nutrient composition of food. Since the majority of advanced students were nutrition majors, they should have been more cognizant of the importance of learning food composition. However, as evidenced by the mean posttest score of 52%, some advanced students have failed to identify the need to learn food composition and/or become motivated to learn sources of nutrients in the diet. Comments from advanced students that they wished they had more time for *SmartBytes,* indicated an interest in, but not a priority to learn food composition. Perhaps increasing time for using *SmartBytes* in the curriculum, or promoting the importance of spending time on the IMM program by offering grade incentives such as including posttest performance in course grade calculations for advanced students or making bonus point awards larger and dependent upon posttest performance, would have enhanced cognitive performance in the present study.

Regardless of the sub-optimal mean posttest scores, the change scores of the IMM groups still were significantly greater than scores for TC groups. Characteristics of the *SmartBytes* IMM program that promoted acquisition, processing, retrieval, and retention of information included: 1) activities requiring active participation, 2) graphics that allowed visualization of foods that stimulated recall of prior information and promoted association of foods together with nutrient data presented, 3) organization of material, 4) variety of formats for presentation of nutrient information, 5) repetition of information, 6) meaningful setting, and 7) navigation and content to allow self-paced progress through the program. Through addressing multiple learning styles, *SmartBytes* enhanced learning of food composition.

ATTITUDE

Change in mean attitude total scores for all groups was less than 3½ points of 75, and differed significantly only between introductory TC and IMM groups.

Mean change scores did not differ significantly between advanced groups or by educational level. Some of the calcium attitude item subsets for various nutrients showed no change, or negative changes.

Reports of food behavior attitude change resulting from an educational intervention are limited. Edwards et al (50) evaluated the change in attitude scores on 8 items regarding general nutrition in 1031 adults completing an American Red Cross class in nutrition and 133 controls completing other classes. Change in the mean total attitude scores for controls of 0.1 from 26.8 to 26.7 for controls was not significant. However, mean attitude scores for those completing the nutrition class increased from 27.5 to 30.8 ($p<.001$). In the current study, changes in scores for the general attitude subsets were significantly greater for the introductory IMM group compared to the TC group ($p=.001$); however, changes for calcium and folate subsets did not differ significantly between any groups.

Internal reliability of the attitude section of the test instrument was poor, as indicated by Cronbach alphas calculated from pre- and post-intervention scores of .43 for introductory students and .31 for advanced students. Thus the accuracy of the attitude measures is questionable, especially for advanced students. The length of the instrument had been limited to avoid overwhelming subjects and increase likelihood of its completion. Limiting the number of items increased the potential for reduced reliability, although alphas of .46 to .94 have been reported for instruments with fewer attitude items (49,50,63).

Evaluation of a correlation matrix of attitude items for introductory students revealed an item on iron was negatively correlated with more than half of the 15 items; a similar evaluation of attitude items for advanced students showed the 2 different iron items were correlated negatively with more than half the advanced items. The Cronbach alpha without the introductory item increased from .43 to .48; alphas without the 2 items for advanced students increased from .31 to .36. Since the effects on the Cronbach alpha values were negligible, the items were retained.

Few Cronbach alphas for only attitude items were reported in the nutrition education literature reviewed. In the current study, alpha coefficients for identical items differed between introductory and advanced groups, suggesting different instruments may have been warranted. Especially for advanced students, attitude items likely did not accurately or consistently identify attitudes, which may have contributed to a lack of measurable change observed in the present study. The lack of consistency in items assessing attitude, i.e. variation in instruments, subjects, and interventions, may be a reason more data on specific food or nutrient attitudes are not available.

While mean total and subset attitude ratings for the current study may be consistent with values seen in nutrition education literature, the small overall changes for total and folate subset scores and lack of changes for the calcium subsets are disconcerting. Further evaluation of attitude items for calcium and folate reveal no significant difference between pre- and post-intervention scores for the 3 calcium items for either educational level or intervention. As shown in Table 19, post-intervention scores for 2 folate items, regarding ease of getting adequate folate (item 6) and folate content of fruits and vegetables (item 9) were significantly greater ($p \leq .001$) than pre-intervention scores for both introductory

Table 19 Mean attitude scores for individual items pertaining to calcium and folate attitudes of students enrolled in introductory nutrition classes

Item number/ statement	**Pre[a]**	**Post**	**Pre**	**Post**
	TC[b]		**IMM**	
	Mean[c] + standard deviation			
8. Adults do not need to include milk in their diet.	4.3±1.0	4.3±0.9	4.1±0.8	4.3±0.9
14. I can easily get adequate calcium from my diet without eating dairy products.	3.7±1.0	3.7±1.0	3.7±0.9	3.7±1.0
15. A diet high in calcium is also high in fat.	3.7±0.9	3.6±0.9	3.9±0.9	4.0±0.8
6. It is easy to eat a diet with adequate amounts of folate[c].	3.2±0.8	3.6±0.9***	3.3±0.8	3.7±1.0***
9. All fruits and vegetables have approximately the same amount of folate.	3.7±0.7	3.9±0.7***	3.8±0.7	4.2±0.7***
12. When eating at restaurants, it is easy to order meals rich in both vitamin A and folate[c].	2.7±0.8	2.9±1.0	2.8±0.9	3.2±1.0***

[a] Pre-intervention score (Pre); Post-intervention score (Post)
[b] Traditional curriculum (TC), n=210; IMM enhanced curriculum (IMM), n=208
[c] Mean from 5-point Likert-type statements; 5 is desired choice of this study
*** $p \leq .001$

TC and IMM groups. For the remaining folate item (item 12), the post-intervention scores differed significantly from pre-intervention scores ($p \leq .001$) for the IMM group. Among advanced students, pre- and post-intervention scores for folate item 6 differed significantly ($p \leq .05$) for TC and IMM groups, while only scores for the IMM group differed significantly for item 9 ($p \leq .01$). For item 12, scores also were significantly different for the TC ($p \leq .01$) and the IMM ($p \leq .001$) advanced groups. Pre- and post-intervention attitude item scores advanced students are provided in Tables 20.

Table 20 Mean attitude scores for individual items pertaining to calcium and folate attitudes of students enrolled in advanced nutrition classes

Item number/ statement	**Pre[a]**	**Post**	**Pre**	**Post**
	TC[b]		**IMM**	
	Mean[c] + standard deviation			
8. Adults do not need to include milk in their diet.	4.4±1.1	4.4±1.0	4.2±1.2	4.3±1.0
14. I can easily get adequate calcium from my diet without eating dairy products.	3.6±1.1	3.6±1.1	3.7±1.2	3.6±1.2
15. A diet high in calcium is also high in fat.	4.4±0.7	4.3±0.7	4.2±0.8	4.2±0.8
6. It is easy to eat a diet with adequate amounts of folate[c].	3.6±1.1	3.9±1.0*	3.6±1.0	3.8±1.0*
9. All fruits and vegetables have approximately the same amount of folate.	4.4±0.6	4.4±0.6	4.3±0.6	4.5±0.8**
12. When eating at restaurants, it is easy to order meals rich in both vitamin A and folate[c].	2.7±0.9	3.1±1.0**	2.7±0.9	3.3±1.1***

[a] Pre-intervention score (Pre); Post-intervention score (Post)
[b] Traditional curriculum (TC), n=60; IMM enhanced curriculum (IMM), n=122
[c] Mean from 5-point Likert-type statements; 5 is desired choice of this study
* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

For the calcium item, "Adults do not need to include milk in their diet," pre-intervention scores exceed the scores reported by Lewis et al (41) of 4.0 for attitudes toward milk drinking. In the current study, mean pre- and post-intervention responses ranged from 4.3 to 4.4 and change was not significant. High pre-intervention scores may have left little room for change. Mean pre- and post-intervention scores for the remaining 2 calcium items from the current study ranged from 3.6 to 4.4 with no significant difference between pre- and post-intervention means. The high scores could reflect the familiarity subjects had regarding calcium sources.

SELF-EFFICACY

The mean change in self-efficacy total scores was significantly greater with IMM intervention. Mean total scores for the 8 items for the introductory group increased more than 21% for the IMM group, significantly greater than the increase of about 10% for the TC group. For the 12 advanced items, smaller changes of 7% for the IMM group and 2% for the TC group were observed. Although self-efficacy items on the test differed, the percent increase for the introductory groups may infer that gains for introductory nutrition students were greater than those of advanced students albeit for lower level tasks. Gains were enhanced by use of the *SmartBytes* program regardless of educational levels. As indicated by Cronbach alphas of .89 calculated from pre- and post-intervention data for both introductory and for advanced self-efficacy items, the internal reliability of the self-efficacy portion of the evaluation instruments was very good.

Engel et al (64) reported a mean gain in self-efficacy scores of 42%, for 41 medical students following completion of a CAI module on diabetic nutrition assessment and counseling. Change scores for the medical students were almost twice the change for the introductory IMM group and 8 times the change for the advanced IMM group from the present study. Mean pre-intervention scores of 57% for the introductory IMM group and 75% for the advanced IMM group were larger than those of the medical students, however. Pre-intervention scores imply medical students possessed less self-efficacy regarding diabetic diets than introductory nutrition students had regarding nutrient composition of foods; advanced nutrition students demonstrated greater self-efficacy regarding assessment of nutrients in diets than either of the other groups. Post-intervention scores of 79% for the introductory IMM group and 80% for the advanced IMM group, were comparable to the 76% for the medical students. Thus, post-intervention mean self-efficacy scores for the medical students and the introductory IMM group from the current study approached the post-intervention score of the advanced IMM group.

By design, opportunities to practice identification and selection of sources of nutrients were dispersed throughout *SmartBytes*. The activity that had users select items to meet half their needs for a specified nutrient from 4 different restaurant menus provided a realistic situation for students to apply knowledge and explore outcomes of their food choices. Coincidentally, students identified selecting for nutrients from restaurant menus as something they had learned. While traditional curricula can effectively impart food composition knowledge, activities providing ample practice in selecting foods to meet nutrient requirements that build self-efficacy are often not included. The consistently greater self-efficacy gains for IMM groups as compared to those in the TC groups indicate use of the *SmartBytes* IMM program successfully enhanced self-efficacy.

INTAKE

To assess changes in food behavior associated with IMM, pre- and post-intervention 1-day food records were obtained from introductory students. Mean calcium and folate consumption, calcium and folate per 1000 kcal, and calcium and folate intake as a percentage of the DRI were calculated from usable food records. Food records were obtained from multiple sites and classes, posing a number of potential problems ranging from accuracy of self-reported intakes to variations in instructions given; for example, some food records were hand written, some were Food Works files, and others were in different analysis program formats. Despite the potential problems, changes in consumption of calcium and folate were observed.

Intervention with the *SmartBytes* IMM program enhanced changes in calcium and folate consumption per 1000 kcal; however, no intervention effect was observed in total intake or percent of DRI for either nutrient. While change in intakes for calcium measures were positive for the IMM group; the TC groups showed negative changes in intake. Changes for both TC and IMM groups were positive for folate measures, with greater changes observed for the IMM group. The change of +51 mg calcium/1000 kcal for the IMM group was significantly different from the change of –29 mg calcium/1000 kcal for the TC group (p=.019). The greater gain in intake of 46 μg folate/1000 kcal for the IMM group that was almost 4 times the increase of 12 μg folate/1000 kcal for the TC group demonstrated a trend toward a larger increase in folate consumption among the IMM subjects compared to that in the TC group (p=0.57). Pre- and post-intervention mean folate/1000 kcal for the IMM group did change significantly from 208 to 253 μg folate/1000 kcal (p=.002), while the observed pre- and post-intervention consumption of 194 versus 206 μg folate/1000 kcal by the TC subjects did not differ significantly.

Kumar et al (46) compared intakes pre- and post-intervention with IMM, CAI, or text. Although they did not report calcium and folate intakes, a mean decrease in fat intake of 42% for the IMM group was significantly greater than decreases of 26% for the CAI group and 19% for the text group (p=.013 and p=.008, respectively between groups. Pre- and post-intervention consumption of vitamin A, vitamin C, and fiber did not differ significantly. In a study of the efficacy of skill-building classes for 173 middle-aged females, Gorbach et al (47) reported a significant difference between mean pre- and post-intervention intakes of 413 and 573 mg calcium/1000 kcal, respectively, (p<.001); no significant change was observed between pre- and post-intervention intakes of 424 and 452 mg calcium/1000 kcal, respectively, for 114 middle-aged controls.

In the current study, mean energy, calcium, and folate values for pre- and post-intervention 1-day food records suggest accuracy of the records was acceptable. Mean energy intakes for the 2 days of 1837 kcal for females and 2679 kcal for males fell within energy levels suggested by the *Food Guide Pyramid* (3) of 1600 to 2200 for females and 2200 to 2800 for males, and for energy intakes observed from national and smaller surveys (6-8,24-26) of 1591 to 2217 kcal for females and 2740 to 3097 kcal for males. Mean calcium intakes reported in the present study of 877 mg for females and 1180 for males were within, if not slightly higher than, means reported by others (6-8,23,24). Mean folate intakes of 382 μg for females and 512 μg for males observed in the current study exceed intakes of 156 to 233 μg for females and 314 to 341 μg for males from prior studies (6-8,23,25). Although the Food Works food analysis program (79) used in the current study contained folate values reflecting enrichment standards, the mean folate intake for females was lower than intakes of 551 to 718 μg reported from studies with folate data adjusted for enrichment (25,26).

As evidenced by the change in intakes of calcium and folate/1000 kcal, the approaches incorporated into *SmartBytes* facilitated change in nutrient consumption. Comparatively, although Kumar et al (46) observed significant differences in fat intake for students completing the interactive CAI program, non-significant decreases in vitamin A and vitamin C intakes also were reported. Authored by 2 of the researchers, Kumar and Barstow, the interactions of *Diet, Nutrition and Cancer Prevention* required students to fill in blanks. Program content focused on cancer initiation, promotion, preventability, and the role of diet, including modifying food behaviors. *SmartBytes* incorporated several simulation activities in addition to fill-in-the-blank and other interactive activities. Colorful food graphics allowed students to visualize and concretely associate nutrient content, portions, and comparisons to other foods. Ideally, the visual association promoted better recall of nutrient content when selecting foods so wiser choices could be made. The application section of each nutrient module provided practice in selecting foods to achieve desired nutrient intake that should have been easily transferable to actual situations. The content of *SmartBytes* focused on the nutrient content of foods and provided practice in selecting foods to meet the DRIs. Thus, the focus of content and activities of *SmartBytes* on the acquisition of knowledge and self-efficacy of wise food selection was more likely to promote behavior change regarding vitamin and mineral intake than traditional curricula or CAI programs with wider content and less interaction.

RELATION BETWEEN COGNITION, ATTITUDE, SELF-EFFICACY, AND INTAKE

The relationships between intervention with the *SmartBytes* IMM program and changes in cognition, attitude, self-efficacy, and consumption of calcium and

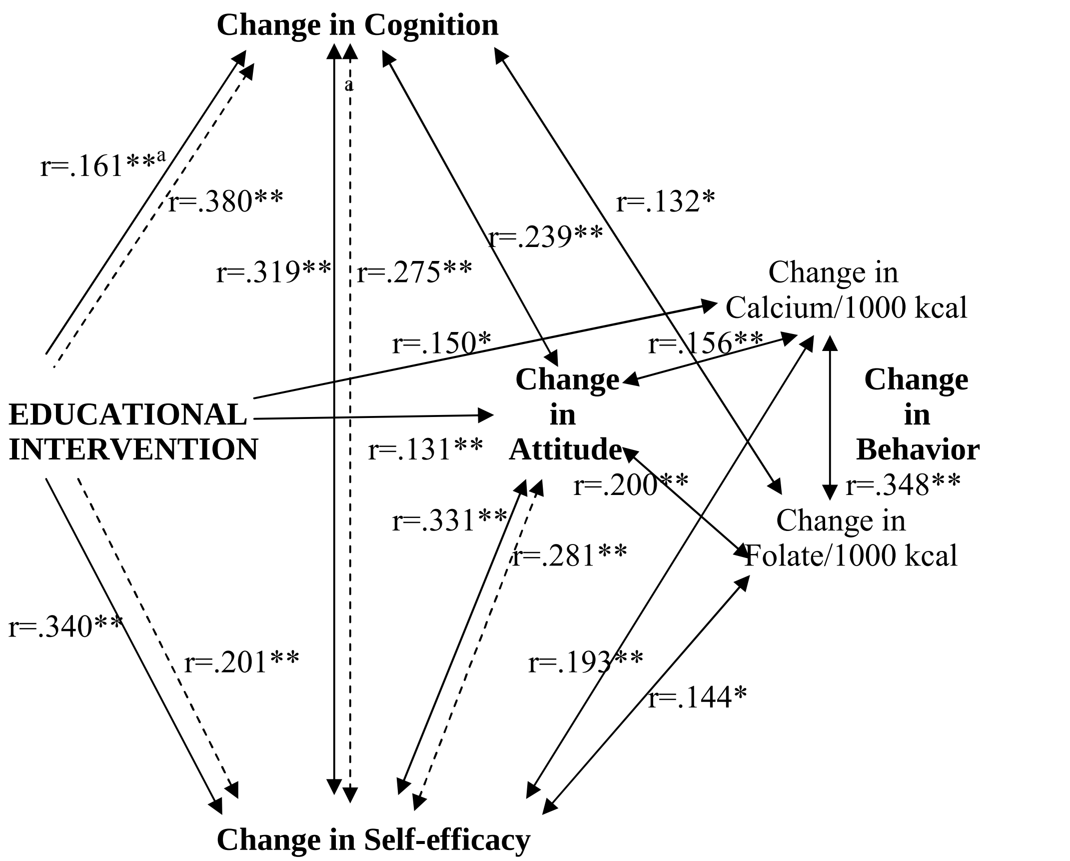

Figure 12 Proposed model for interaction between educational intervention and changes in knowledge, attitude, and self-efficacy food behavior

[a] Pearson correlation coefficients for introductory students (⟶); advanced students (- - ▸)

$^{*}p \leq .05$, $^{**}p \leq .01$

folate/1000 kcal are illustrated in Figure 12. As represented by solid and dashed arrows, for both advanced and introductory levels, instructional method was correlated with changes in self-efficacy and cognitive scores. Only change in self-efficacy was correlated with instructional method, and changes in cognition and attitude for both educational levels. Self-efficacy plays a vital role in promoting behavioral change, as evidenced by the addition of self-efficacy to the health behavior model (12,31-34), inclusion in the stages of change model (10), and as a basic construct of social cognitive theory (11-13,33,38,41-44).

For introductory students, educational intervention was correlated with change in attitude; changes in cognition and self-efficacy also were correlated with change in attitude. *SmartBytes* incorporated instructional techniques and content to improve cognition and enhance self-efficacy, but did not directly address changing attitudes. Therefore, the relationship between attitude and instructional intervention likely is an indirect one that is the result of direct relationships between changes in cognition and self-efficacy. Educational intervention also predicted change in calcium/1000 kcal, as did changes in attitude and self-efficacy. However, a large correlation between changes in calcium/1000 kcal and folate/1000 kcal (Table 14) may suggest the relationship with intervention may be one of general increased awareness of food selection.

When promoted by instructional intervention, self-efficacy appears to play an important role in altering attitude and improving consumption of calcium and folate/1000 kcal. Change in self-efficacy was correlated with changes in cognition and attitude for both groups. Although it might seem cognition promoted self-efficacy, activities that enhanced self-efficacy, such as selecting from menus, likely also contributed to reinforcement and/or increases in cognition. Changes in cognition and attitude were correlated for introductory students but not for advanced students. Therefore, it might be implied that self-efficacy may have a greater influence on attitude than does cognition.

Changes in self-efficacy and attitude for introductory students were correlated with changes in both calcium and folate/1000 kcal, while cognition was related to only change in folate/1000 kcal. The activities that provided practice in selecting sources of calcium or folate also fostered self-efficacy. As described previously, change in self-efficacy enhanced change in attitude, so the effects of attitude on intake also may reflect self-efficacy. Thus, it appears that self-efficacy likely had greater influence on intake than did attitude.

Although no study reviewed reported correlations for all measures evaluated in the current study, Edwards et al (50) measured change in knowledge, belief, and behaviors following educational intervention. Significant correlations were observed between pre- and post-intervention change in knowledge scores and both change in belief scores ($r=.21$, $p \leq .05$) and change in behavior scores ($r=.15$, $p \leq .05$). Changes in belief and behavior also were significantly correlated ($r=.26$, $p \leq .05$). Self-efficacy was not measured and correlations of the measures with intervention were not identified.

Several studies reported relationships between some of the measures based on single surveys. Frederick and Hawkins (28) evaluated knowledge, attitudes, food intake, and bone densities in 59 college-aged or post-menopausal females. Correlations were identified between knowledge scores regarding basic nutrition with food frequency scores for high calcium foods of r=.38 ($p \leq .001$); attitude scores concerning nutrition, foods, and food behaviors were correlated with food frequency scores (r=.22, $p \leq .05$). Marietta et al (49) assessed knowledge, attitude, and food label use of 208 college students enrolled in a life science course. Correlations were reported between knowledge and attitude (r=.14, $p \leq .04$), knowledge and general label use (r=.87, $p \leq .0001$), and attitude and general label use (r=.27, $p \leq .0001$). A survey of 1040 adults by Wardle, Parmenter, and Waller (51) indicated knowledge was correlated positively with intake of fruit (r=.23, $p \leq .001$), vegetables (r=.36, $p \leq .001$), and negatively with fat intake (r=-.21, $p \leq .001$). In the current study, instructional intervention promoted change in knowledge and attitudes that was correlated with change in food behaviors.

As found in the present study, others have observed self-efficacy to be correlated with change in food habits. From a survey of 117 grocery shoppers, Contento and Murphy (33) observed the correlation of self-efficacy (r=.18, $p < .05$) with self-reported change in consumption of red meat and/or butter plus an additional change such as increased vegetable intake, decreased salt intake, or other *Dietary Guidelines* recommendation. Slater (42) also reported a correlation of knowledge with self-efficacy (r=.13, $p \leq .01$) from 3 successive waves of surveys of 600 adults over a period of 6 years. Self-efficacy was correlated with food behavior assessed by 1-day food records (r=.43, $p \leq .001$), and with age

($r=.09$, $p \leq .05$). Knowledge also was correlated with food behavior ($r=.39$, $p \leq .001$) and with gender ($r=.09$, $p \leq .05$) in Slater's sample.

Results of studies evaluating knowledge, attitude, self-efficacy, or food behavior from surveys, rather than change in measures, also demonstrate significant correlations between the various measures (28,33,42,49-51). Although not observed in the present study, knowledge has been correlated with gender and self-efficacy with age (42). In the present study, years of education were negatively correlated with change in attitude for advanced students. Perhaps as knowledge or perceived knowledge accumulates, malleability of attitudes decreases, or possibly the observation was an anomaly associated with the population studied.

EDUCATIONAL INTERVENTION

The *SmartBytes* IMM program was well received by both advanced and introductory students. Students found the program helpful, and liked the colorful graphics and selecting from restaurant menus. Some students would like to have spent more time on the program, and others offered suggestions for additional information for the current modules and topics for new modules.

Some students in the current and reviewed studies felt the programs assessed required too much time. Raidl et al (55) noted mean time for dietetics students on a clinical reasoning tutorial program was 95 minutes, almost twice the 53 minutes spent on a drill-and-practice program. Kolasa et al (58) reported mean time spent by medical students on a cardiovascular program was about 2 hours. Kohlmeier et al (65) observed medical students use of a cancer and nutrition program to be about 3.3 hours, not including self-assessment exams; time increased to 5.1 hours if exams were completed. Mean time on all 4 nutrient modules for the current study was less than 2 hours for introductory and 2-3 hours for advanced students.

When students ranked instructional methods of lecture, textbook, *SmartBytes,* and diet analysis assignment in order of helpfulness in learning food composition, about 39% of advanced students ranked *SmartBytes* first, compared to 17% for introductory students, who preferred lecture. The difference in ranking of *SmartBytes* may illustrate the progression from novice toward expert. While novices (introductory students) acquire knowledge of basic facts through lecture, advanced students may prefer to expand upon and learn how to apply knowledge learned in introductory courses via instructional methods such as the *SmartBytes* IMM program. Carew et al (60) reported 62% of their subjects preferred lecture, while 29% thought lecture was not necessary with the CAI study guide. Although grades were significantly better for material covered in a CAI simulation lab, Richardson (57) reported medical students rated lecture as more effective in teaching muscle mechanics (7.7 of 10) than the CAI lab (4.2) or computer-assisted lecture (3.8). Results of the present study and studies reviewed indicate that although IMM and CAI enhanced performance, many students, particularly at the introductory level, still preferred lecture and time use seemed to be a primary issue.

CRITIQUE

The current study is unique, as it appears that to date, no one study has provided a model for evaluating change in cognition, attitude, self-efficacy, and nutrient consumption in conjunction with different instructional methods. Compared with studies in the literature reviewed, there were both strengths and weaknesses in the present study design, implementation, and results. Figure 13 delineates assets and suggestions for *SmartBytes*.

1) *SmartBytes* was developed and tested with primary input from 4 people with different learning styles. The interactions within the group afforded exposure to the thinking of others and a variety and depth of experiences in meeting instructional needs

2) The final instrument and instructions to preceptors should have been pilot tested and/or more interaction between the investigators and preceptors should have been facilitated.

3) Active participation when assessing IMM needs to become a priority for both students and preceptors.

4) Different material and approaches may produce greater changes in attitude.

Figure 13 Critique of SmartBytes IMM program

SUMMARY AND THE FUTURE

Instructional intervention of the *SmartBytes* IMM program with students in introductory and advanced nutrition classes significantly improved changes in cognition, attitude, self-efficacy scores, and in the consumption of calcium/1000 kcal compared to means of students in traditional nutrition curricula; changes in folate/1000 kcal showed a strong trend of improvement with IMM enhanced curricula. *SmartBytes* actively engaged the learner, provided opportunities to practice and reinforce learning, and facilitated learning of concepts through visual representation and presentation of information in multiple formats. Frequent activities that required application of knowledge promoted the development of self-efficacy. Enhancement of cognition and self-efficacy inspired changes in attitude for beginning students in nutrition. Improvements in consumption of calcium and folate/1000 kcal also occurred in this group with *SmartBytes* intervention. The mechanism motivating the improvement could be related to: attention to food selection in general stimulated by *SmartBytes*, increased cognition of nutrient composition of food promoting more informed food choices, increased self-efficacy regarding ability or ease of selecting good sources of calcium and folate, and change in attitudes regarding the need or acceptability of sources of calcium and folate. Whatever the motivation, change in consumption of calcium and folate/1000 kcal were observed over a short time period in college students.

Student feedback and critical evaluation of the study have afforded many ideas for enhancement of *SmartBytes*, topics for additional modules, and better assessment for related studies. Several functions were considered but not completed before testing. 1) The program map, accessed from the pull-down menu, also was to show the user what sections they had completed, and where in the program they currently were. This could be accomplished by tracking progress through the program, unseen to the user; however, it would require use of a separate user file to record information in order to carry over information between uses. Tracking also would enable future researchers verify program use and to see how the program was used. 2) From the pull-down file, users should be able to turn audio off and on. 3) How to exit the program needs to be made more obvious.

Student feedback regarding length, and additional information desired led to other ideas for improving the program. The program might be shortened by placing the DRI and nutrient density sections in separate modules; as preceptor feedback during program development yielded a variety of responses regarding which sections were most important, different module sections might be used if available as individual programs. Giving users more opportunities to skip multiple examples also could shorten the program; this would allow learners the choice of skipping examples for concepts repeated from previous nutrient modules, such as calculating servings to meet the DRI.

Although objectives were enumerated at the beginning and end of each module section, some students need to be told they met the specific objective immediately upon completing an activity; some students wanted even more detailed information on what to expect. Nutrient tables from the pull-down menu could be made available for printing. An additional, printable, activity that had students fill in the DRI, name some sources, and identify some sources they were going to try to incorporate into their diet would provide a review and perhaps motivation to make wise food selections. Additional menus and information regarding vegetarianism might be appropriate as part of current modules. Menus for selecting fast food and more vegetarian items would enhance self-efficacy of a larger group of users. For example, although hamburgers, fries, tacos, cola, and milkshakes were choices on different menus currently in the program, some users seemed not to recognize fast food items when offered in menus of settings other than eateries with drive through windows.

More nutrient modules were requested, including ones for vitamin C and fats. Based on CFSII survey data (7), mean intakes for young adult females did not meet the DRI for magnesium and zinc so those 2 nutrients would be likely candidates for future modules on nutrient composition. Sources of antioxidants such as vitamins C and E would be of interest to a growing audience. Mixed foods that included oils rich in vitamin E would have to be the emphasis of a module on vitamin E, as the major sources are less palatable alone. Selenium would receive interest, but since the selenium in the soil is a major determinant of food content of this nutrient, an instructional module is not practical.

With both the growing interest in sports nutrition and an aging population facing potential cardiovascular problems, modules for potassium and sodium composition of food might be appropriate. A module on protein could include both wise selection of animal protein and use of meat substitutes. With the success of *SmartBytes* in enhancing self-efficacy and improving nutrient consumption, modules on selecting complex carbohydrates, increasing fiber, or decreasing fat could alter food selection; these modules could focus on applications of selecting from menus and identifying desired components in mixed dishes.

Efficacy of the program could be improved by promoting its use as part of course grades and increased availability through distribution of individual CDs or via the Internet. Providing very specific instructions to preceptors would enhance consistency in administration of the instruments, program use, and collection of food records. Finally, more time between collection of food records, or a third food record, would give a better idea of whether changes were maintained. The short time between obtaining food records may not have given a true picture of whether eating behaviors were actually changed.

A second posttest for follow-up testing would better indicate retention of cognition, attitude, and self-efficacy changes. More time between test instruments may have mixed results. Cognition may decrease over time, or cognition could increase if students access and spend more time on the program.

Over time, self-efficacy may continue to increase with additional time to practice or access the program; whether self-efficacy decreases over time would be interesting to observe. Based on correlations identified in the current study, attitude would likely follow self-efficacy.

Chapter 6: Summary and Conclusions

The effectiveness of interactive multimedia (IMM) enhanced nutrition curricula was compared to traditional curricula (TC). A 4-module IMM program, *SmartBytes*, that presented nutrient composition of foods for the nutrients calcium, folate, iron, and vitamin A was developed at The University of Texas at Austin. This dissertation focuses on the effects of the total program and the calcium and folate modules. Changes in cognition, attitude, and self-efficacy were assessed by performance on pre- and post-intervention multiple choice instruments administered to students enrolled in introductory and advanced nutrition classes at 7 universities across the United States. Consumption of the 4 nutrients, calcium, folate, iron, and vitamin A, were calculated from pre- and post-intervention 1-day food records collected from introductory students. Students in IMM classes provided feedback on the program and its use.

Although changes in cognition for both introductory and advanced IMM groups were significantly larger than for the corresponding TC groups, the changes were small. Performances on the posttests were sub-optimal. For students completing the IMM programs, gain scores were 11% and 13% on average, for introductory and advanced students, respectively. Motivation to spend adequate time to learn the material presented in the *SmartBytes* IMM program and to demonstrate higher achievement on posttests appeared to be limited for many subjects. Greater gains have been reported in nutrition education literature for medical students, educational psychology students, and nutrition students when participation was required. It is hypothesized that including posttest performance as part of course grades could improve motivation to learn the material and to do well on posttests. Also, if students perceived a greater value in learning food composition, that could provide further motivation to learn.

Difficulties encountered establishing desired reliability of instruments for measuring attitudes and lack of positive results may be reasons few studies have reported changes in attitude in conjunction with educational interventions. Attitudes develop as the result of a variety of influences and are difficult to change under the best circumstances. Mean total attitude and mean folate subset change scores for introductory students differed significantly by educational intervention, while those for advanced students did not differ. Changes in attitude for calcium items subsets were near 0 or slightly negative, while changes for folate subsets were positive.

Increases in self-efficacy scores were significantly greater for IMM than for corresponding TC groups. Selecting from restaurant menus and other *SmartBytes* activities likely promoted increased self-efficacy for students completing the IMM program. Intervention with IMM also resulted in a significantly greater change in calcium consumption per 1000 kilocalorie (kcal) and a trend toward greater change in folate per 1000 kcal when compared to reported intakes of students in traditional nutrition curriculum. Mean intakes of calcium and folate were within those reported in nutrition literature.

The present study evaluated relationships of instructional intervention, and changes in knowledge, attitude, and food behavior represented by change in calcium and folate/1000 kcal. Instructional intervention was correlated with changes in cognition and self-efficacy for both educational levels, and with changes in attitude and calcium/1000 kcal for introductory students. Correlation coefficients for instructional intervention were largest with change in cognition for introductory students and with change in self-efficacy for advanced students. Change in self-efficacy scores was correlated with changes in cognition and attitude scores for both educational levels, and with calcium and folate/1000 kcal for introductory students. For introductory students, knowledge and attitude were correlated, and folate/1000 kcal was correlated with knowledge, attitude, and calcium/1000 kcal. Years of education were negatively correlated with changes in attitude scores for advanced students.

Students liked using the IMM program, but many commented that the program required too much time in addition to the regular curriculum. Inclusion of the IMM program as part of the graded course curriculum may have increased acceptability as well as potentially increasing posttest scores. Written comments by 36 of the 238 students responding referred to the restaurant menu activity in the Applications sections, where students tried to meet half their daily nutrient requirement when selecting meals from 4 restaurant menus; written comments usually did not specifiy other activities or module sections. Thus, selection from restaurant menus was a popular activity that also likely promoted self-efficacy. Compared to lecture or text, *SmartBytes* was preferred by advanced students, but not introductory students who preferred lecture.

The success of the *SmartBytes* IMM program developed and tested in the current study in enhancing cognition, self-efficacy, and improving food behaviors was a step in the right direction for nutrition educators. Although cognition can be attained through traditional instructional methods, it is increasingly difficult to provide opportunities for development of self-efficacy. *SmartBytes* answers both a need to enhance knowledge of food composition and simultaneously builds self-efficacy regarding application of food composition knowledge. Future studies are needed to determine how retention compares to traditional curriculum, and perhaps how attitudes might be altered for students enrolled in advanced nutrition classes through IMM programs.

Appendices

Appendix A

Program Objectives

CALCIUM OBJECTIVES

DRI SECTION
Identify the DRI as 1000 mg for an adult.
- Identify milligrams as the units of measure for calcium.
- Identify foods that contain at least 300 mg calcium in a single serving.
- Choose 3-6 foods that, when combined, meet 50% of the DRI for calcium.

SOURCES SECTION
- Identify milk as the key food source for calcium.
- Identify the calcium content of milk as 300 mg for 8 oz.
- Identify that milk has 30% of the DRI for calcium.
- Identify calcium sources meeting at least 30% of the DRI per serving.
- Identify "good" calcium sources providing 5% of the DRI per serving.
- Rank foods by calcium content, relative to the key food.

NUTRIENT DENSITY SECTION
- Identify the effects of fortification and bioavailability on calcium content
- Calculate the Index of Nutrient Quality for calcium of a given food.
- Rank foods according to nutrient density for calcium.

APPLICATIONS SECTION
- Choose the meal highest in calcium from a given selection.
- Identify the approximate percentage of the DRI for calcium from a diet history.
- Based on client recall, identify at least 2 ways to increase the intake of calcium to meet 90% of the DRI.
- Identify components of mixed dishes and estimate the calcium content of the dish.
- Select a meal that meets 50% of the DRI for calcium from a restaurant menu.

FOLATE OBJECTIVES

DRI SECTION

- Identify the DRI for folate for a non-pregnant adult as 400 micrograms
- Recognize there is an increase in the DRI for folate for pregnancy.
- Identify the units of measure for folate as micrograms
- Identify foods that contain at least 100 mcg folate in a single serving.
- Identify foods that contain at least 100 mcg folate in a single serving.

SOURCES SECTION

- Identify the orange as the key food source for folate.
- Identify 50 mcg as the folate content of a three-inch diameter orange.
- Identify that the orange has more than 10% of the DRI for folate.
- Identify "good" folate sources providing 10% of the DRI per serving.
- Identify folate sources meeting at least 5% of the DRI per serving.
- Rank foods by folate content, relative to the key food.

NUTRIENT DENSITY SECTION

- Identify processing and preparation methods that decrease the folate content of foods.
- Identify which foods are enriched with folate.
- Calculate the INQ for folate of a given food.
- Rank foods according to nutrient density for folate.

APPLICATIONS SECTION

- Choose the meal highest in folate from a given selection.
- Identify the approximate percentage of the DRI for folate from a diet history.
- Based on client recall, identify at least two ways to increase the intake of folate to meet 90% of the DRI.
- Identify components of mixed dishes and estimate the folate content of the dish.
- Select a meal that meets 50% of the DRI from a restaurant menu.

Appendix B

Needs Assessment Pretest

PRETEST ON FOOD COMPOSITION

VITAMIN A

1) One-half of a fresh medium carrot (1.25 oz) supplies approximately what percent of the RDA for adult males for Vitamin A?

A) 10
B) 25
C) 50
D) 100
E) 200

2) Approximately how many retinal equivalents are found in 1/2 of a fresh medium carrot?

A) 2000
B) 1000
C) 500
D) 250
E) 100

3) Which of the following foods are higher in Vitamin A than 1/2 of a fresh medium carrot?

A) Broccoli - 1 c. steamed
B) Cantaloupe - 2 c. pieces
C) Spinach - 1 c. microwaved
D) Green beans - 1 c. steamed cooked
E) Milk - 8 oz. fresh skimmed fortified

4) Taking into account the important concept of nutrient density, which of the following foods is the best choice to get Vitamin A. *(Assume that standard - not reduced fat- recipes have been used.)*

A) Caesar salad, 2 c.
B) Spinach lasagna, 4 oz.
C) Broccoli cheese soup, 1 c.
D) Spinach salad, 2 c. with ½ hard cooked egg and 3 T. hot bacon dressing
E) 1 medium baked sweet potato with 1 T. butter

5) Taking into account the important concept of nutrient density, which of the following foods is the best choice to get Vitamin A. *(Assume standard serving sizes and that standard - not reduced fat- recipes have been used.)*

A) Pumpkin pie
B) Peach crisp
C) Apricot cheesecake
D) Carrot cake
E) Cherry cobbler

6) Which of the following foods **MUST** be fortified with vitamin A?

A) Oatmeal
B) Orange juice
C) Skim milk
D) Non-fat yogurt
E) Enriched bread

IRON

7) One 3 oz serving of cooked lean beef supplies approximately what percent of the RDA of iron for an adult female?

A) 100	C) 50	E) 10
B) 75	D) 20	

8) Approximately how many milligrams of iron are found in one 3 oz serving of cooked lean beef?

A) 1	C) 5	E) 15
B) 3	D) 7	

9) Rank these food from high to low for iron content.

1) Roasted pork loin, 3 oz.
2) Baked flounder, 3 oz
3) Broiled beef tenderloin, 3 oz.
4) Broiled ground beef patty, 3 oz.
5) Roasted turkey breast, 3 oz.

A) 2,4,1,3,5	C) 4,5,3,1,2	E) 3,4,1,5,2
B) 3,1,2,4,5	D) 3,4,5,2	

10) Which of the following foods contain three or more milligrams of iron?

A) Raisins - 2 tablespoons
B) Whole wheat bagel, 2 oz. Toasted
C) Cabbage - 1/2 c. cooked
D) Pinto beans - 1 c. cooked
E) Enriched pasta - 1 c. cooked

11) The iron in meat is how many times more available than the iron in vegetables and grains.

A) 1	C) 5	E) 15
B) 3	D) 10	

12) Which of the following decreases the body's absorption of iron?

A) Consuming animal tissue protein
B) Concurrent consumption of vitamin C
C) Very high fiber diets
D) Physiological need for iron
E) Increased gastric acidity

13) Which of the following statements best describes the meaning of an INQ (Index of nutritional quality) of 1.6 for iron for a serving of a casserole?

A) The casserole is a poor source of iron.
B) The RDA for iron will be met if one eats enough casserole to provide 2000 kcal.
C) The casserole contains a lot of fat.
D. The casserole provides 1.6 mg of iron for every 100 kcal.
E. The amount of iron in the casserole per kcal is 1.6 times better than the total diet Needs to be in order to supply adequate iron.

FOLATE

14) How many micrograms of folic acid per day are required to meet the current RDA for for an adult male?

A. 100 | C. 300 ug/day | E) 800 ug/day
B. 200 | D. 400 ug/day

15) A 4 oz orange provides what percent of the current RDA for folate for an adult male?

A. 100 | C. 50 | E) 5%
B. 75 | D. 25

16) How many 4 oz fresh oranges do you need to meet the current RDA for folate for a 30 year-old pregnant woman?

A. 16 | C. 4 | E) 1
B. 8 | D. 2

For items 17-22, select the answer which best represents how the folate content of each of the following foods compare to that of a 4 oz fresh orange?

A. Greater than the orange | B. Same as the orange | C. Less than the orange

17) Freshly squeezed orange juice, ½ c.?

18) Medium banana, 1 medium?

19) Spinach, 1 c fresh chopped?

20) Pinto beans, 1 c. cooked?

21) Oatmeal, 1 c. cooked?

22) Folate is currently added to which of the following foods?

A. Ready-to-eat, fortified breakfast cereal
B. Enriched bread | D. Fortified skim milk
C. Enriched flour | E. Fortified refrigerated orange juice

CALCIUM

23) How many milligrams of calcium per day are required to meet the current RDA for a 19 year-old male?

A. 600 | C. 1000 | E. 1400
B. 800 | D. 1200

24) One cup of skim milk provides about what fraction of the current RDA for calcium for a 19 year-old male?

A. 1/4 | C. 1/2 | E) 3/4
B. 1/3 | D. 2/3

25) How many cups of skim milk does a 28 year-old pregnant woman need to meet the current RDA for calcium?

A. 8 | C. 4 | E. 1
B) 6 | D. 2

26) Rank the following in order of most to least calcium content:

1. Cheddar cheese, 1 oz.
2. Plain yogurt, 1 c.
3. Ice cream, 1 c.
4. Skim milk, 1 c.
5. Cottage cheese, ½ c.

A 2, 4, 1, 3, 5 | C. 4, 2, 1, 5, 3 | E) 4, 5, 2, 1, 3
B. 2, 4, 5, 3, 1 | D. 5, 4, 1, 2, 3

27) Which food supplies the most calcium per kcal?

1. Cheddar cheese, 1 oz.
2. Regular strawberry yogurt, 1 c.
3. Ice cream, 1 c
4. Skim milk, 1 c.
5. Cottage cheese, ½ c.

For numbers 28 - 32, select the answer representing the approximate amount of the listed food that one would need to eat to obtain the calcium equivalent of 1 c. of skim milk. Do not assume enrichment or fortification of any of these foods with calcium.

A. <1 cup | B. 1 cup | C. ≥ 2 cups

28) Cooked pinto beans?

29) Steamed broccoli?

30) Dry roasted peanuts?

31) Orange juice?

32) Cooked enriched macaroni?

Additional test questions for advanced students

Evaluation of Dietary Records

For items 33-40, select the answer that best represents a reasonably accurate evaluation that might be made without the use of computer analysis or food composition tables of the dietary record provided for the listed nutrient.

A) Adequate – supplies >= two-thirds of the DRI
B) Inadequate – supplies < two-thirds of the DRI
C) Insufficient information to assess

MA is a 23-year-old adult female. Her 24-hour recall indicates that he consumes 4 8-oz glasses of 2% milk, 1 oz. of Wheaties with 1 banana, a donut, 2 hamburgers (2 oz. Meat, enriched bun, pickles, mustard, and catsup each), 2 oz. French fries, 1 c. enriched spaghetti with ½ c. meat sauce, ½ c. green beans, 2 oz. raw carrot sticks, 1 c. vanilla ice cream and 2 cokes daily.

33. Vitamin A?

34. Iron?

35. Folate?

36. Calcium?

JJ is a 76-year-old male who participates in a congregate meals program at the local Senior Activities Center. At the center, the lunch usually provides a 3 oz. serving of meat, ½ c. potatoes or rice, a cooked vegetable, 1 enriched or whole wheat roll, 1 t. margarine, 8 oz. 2% milk, a baked dessert, and coffee. At home, he eats 1 c. cooked oatmeal with ¼ c. whole milk, 2 slices enriched white toast with 2 t. butter and 2 t. jelly, and 2 c coffee with 2 t. sugar for breakfast and a frozen TV dinner (2 oz. meat, ½ c. starch, ½ c. cooked vegetable) plus 2 slices enriched white bread and coffee. Daily snacks include 1 c. of apple juice or peach nectar and an occasional bowl of 1 c. ice cream or 2 c. popcorn.

37. Vitamin A?

38. Iron?

39. Folate?

40. Calcium?

Appendix C

Abstracts

ABSTRACT

TITLE: ACQUISITION OF FOOD COMPOSITION DATA—A LIMITED RETENTION PHENOMENON

AUTHOR(S): L.O. Michalsky, M.A., R.D., M. Meadows, R.D, L.D.,

B. Gillham, PhD., R.D., L.D., R. Loop, Ph.D.

LEARNING OUTCOME: Participants will recognize that students at six institutions across the country are very similar in their knowledge of food composition and that retention in knowledge between beginning and advanced students are small.

ABSTRACT: Registered dietitians are the acknowledged translators of nutrition information; they must acquire and retain information about food composition to effectively and quickly interact with clients regarding food choices. Traditional sources of student's food composition knowledge include course work and applications such as dietary analyses, menu planning, and label comparisons. The purpose of this study was to determine the time line and complexity of knowledge acquisition as measured by the ability to recall and manipulate food composition data in two groups of students: beginning and advanced. If the often tedious and labor intensive reference to food composition manuals or nutrient data bases used in the past helped imprint food composition values in students' memories, major increments in knowledge should be associated with the classes that stress this process. However, when computer-based nutrient analysis replaces the former, such increments may not occur. Food composition knowledge of beginning and advanced students at The University of Texas at

Austin and at five other locations across the country was assessed. The testing instrument utilized multiple choice items for vitamin A, folic acid, calcium, and iron that were developed in Fall 1996 and administered early in the Spring semester, 1997. Retesting at the end of the semester will indicate knowledge acquisition under current instructional methods. Pre-test mean raw score for the 32 items for 472 students, 393 beginning and 129 advanced, did not differ significantly ($p < 0.11$). Beginning students scored 10 ± 3, or 31 ± 10% (mean ± SD); advanced students scored 14 ± 3, or 44 ± 9%. Mean raw scores for students at the six institutions ranged from 8 to 11 for beginning students and 18 to 20 for advanced. Since advanced students have completed the introductory course, there appears to be limited retention of food composition knowledge gained. It is possible that alternate instructional methods, more attention to repetition of major themes or additional applied experience could enhance retention of knowledge.
Funded in part by USDA Higher Education Challenge Grant

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ABSTRACT

TITLE: FOOD COMPOSITION KNOWLEDGE OF ADVANCED NUTRITION STUDENTS

AUTHOR(S): M.R. Meadows R.D., , L.O. Michalsky, R.A., R.D., R. Loop, Ph.D., B. Gillham, Ph.D., R.D., L.D.

LEARNING OUTCOME: To assess the competency of comprehension knowledge versus application skills of students beginning an upper division course in medical nutrition therapy.

ABSTRACT: Food composition is the unique skill that the registered dietitian brings to the health care team. With the explosion of scientific knowledge and crowding of the curricula opportunity for hands on application of new information is reduced. Students can learn and recite information given in lecture or found in their textbook, but applying this information is not a skill many of the students acquire. Enhancing food Selection Behaviors of Americans with Individualized Multimedia Curricula is a project funded by a USDA higher education challenge grant to create and test a multimedia program for food composition. The design Multimedia Curricula will allow students to practice application skills as they are acquired. Objectives for modules on vitamin A, folic acid, calcium and iron were developed and multiple choice pretests designed during fall, 1996. Pretests were administered spring, 1997 to students at six universities across the United States. Upper division students taking a beginning class in Medical Nutrition Therapy

were evaluated on their performance of the comprehension versus the application questions of the pretest. Comprehension was defined as identifying, recalling and deducing information. Application was defined as comparing, analyzing and evaluating information. The students had a mean score of 10.79 on the comprehension questions (with a standard deviation of 2.296). The mean score on the application questions was only 7.8 (with a standard deviation of 2.2). Student's t-test indicates that this is a significant difference with $p < .001$. We anticipate that scores in both areas will improve with the posttest. We further anticipate there will be a narrowing in the difference between the comprehension and application evaluations in the posttest; with an even greater narrowing evidenced in testing following use of the Multimedia Curricula.

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Appendix D

Test Instruments

MULTIMEDIA PRETEST (for Introductory Nutrition Classes)

For research data, please fill in all the personal data section of the *Scantron* sheet.

*****Name *****Grade or Educ (years of education completed)

*****Sex *****Social security number (optional)

*****Birthdate *****Test form - blacken the letter **B**

*****In the first column of Special Codes, blacken:

Nutrition Majors blacken **1** Non-majors blacken **2**

SECTION I

On the *Scantron* sheet, please mark one of the five responses based on your attitude regarding each statement below.

1. All foods eaten in moderation provide the nutrients needed for good health.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

2. Trying to eat a balanced diet is too complicated and confusing.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

3. All fruits and vegetables contain approximately the same amount of vitamin A.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

4. A diet without meat is likely to be deficient in iron.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

5. The color of the flesh of a fruit or vegetable is a good indicator of the vitamin A content.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

6. It is easy to eat a diet with adequate amounts of folate.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

7. A diet without meat can easily meet my nutrient needs.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

8. Adults do not need to include milk in their diet.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

9. All fruits and vegetables have approximately the same amount of folate.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

10. Most people get enough iron in their diet.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

11. It is easy to eat a diet with adequate amounts of vitamin A.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

12. When eating at restaurants, it is easy to order meals rich in both vitamin A and folate.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

13. Enriched cereal is a good source of vitamins and minerals.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

14. I can easily get adequate calcium from my diet without eating dairy products.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

15. A diet high in calcium is also high in fat.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

16. I can list four food sources that provide at least 200 mg of calcium per serving.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

17. I can list four food sources that provide at least 250 RE of vitamin A per serving.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

18. I can list four food sources that provide at least 1.5 mg of iron per serving.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

19. I can list four food sources that provide at least 100 mcg of folate per serving.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

20. I am able to identify foods high in iron from a restaurant or cafeteria menu.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

21. I am able to identify foods high in vitamin A from a restaurant or cafeteria menu.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

22. I am able to identify foods high in folate from a restaurant or cafeteria menu.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

23. I am able to identify foods high in calcium from a restaurant or cafeteria menu.
(A) Strongly Agree (B) Agree (C) Neutral
(D) Disagree (E) Strongly Disagree

SECTION 2
On the *Scantron* sheet blacken in the best answer to each question.

24. One fresh mini carrot (1/3 oz. - approximately 1/8 of a large carrot) supplies approximately what percent of the RDA for adult males for vitamin A?
A) 10%
B) 25%
C) 50%
D) 100%
E) 200%

25. Which of the following foods is the richest source of vitamin A?
A) Cooked corn, 1/2 cup
B) Avocado, 1/2 small
C) Orange, 1 medium
D) Fresh Bing cherries, 1 cup
E) Cooked winter squash, 1/2 cup

26. Which of the following foods the richest source of vitamin A?
A) Steamed broccoli, 1/2 cup
B) Cantaloupe, 1/2 cup
C) Romaine lettuce, 1 cup
D) Steamed green beans, 1/2 cup
E) Fortified skim milk, 8 oz.

27. Taking into account the concept of nutrient density, which of the following foods is the best choice to get vitamin A. *(Assume that standard - not reduced fat- recipes have been used.)*
A) Caesar salad, 2 cup
B) Spinach lasagna, 4 oz.
C) Broccoli cheese soup, 1 cup
D) Spinach salad, 2 cup with 1/2 hard cooked egg and hot bacon dressing
E) Sweet potato, 1 medium baked with 1 Tbsp. butter

28. Taking into account the concept of nutrient density, which of the following foods is the best choice as a source of vitamin A. *(Assume standard serving sizes and that standard - not reduced fat- recipes have been used.)*
A) Pumpkin pie
B) Peach crisp
C) Apricot cheesecake
D) Carrot cake
E) Cherry cobbler

29. Which of the following foods MUST be fortified with vitamin A?
A) Oatmeal, traditional quick cooking
B) Orange juice
C) Skim milk
D) Non-fat yogurt
E) Enriched bread

30. One 3 oz. serving of cooked lean beef supplies approximately what percent of the RDA
A) 100%
B) 75%
C) 50%
D) 20%
E) 10%

31. Which food is highest in bioavailable (most easily absorbed and utilized) iron?
A) Raisins, 1/4 c.
B) Cooked salmon, 3 oz.
C) Fresh spinach, 1 cup
D) Cooked pinto beans, 1/2 cup
E) Skim milk, 1 cup

32. Which food is highest in bioavailable (most easily absorbed and utilized) iron?
A) Pinto beans, 1 1/2 cup
B) Baked flounder, 3 oz.
C) Broiled beef tenderloin, 3 oz.
D) Baked pork chop, 3 oz.
E) Roasted turkey breast, 3 oz.

33. Which of the following foods contain three or more milligrams of iron?
A) Raisins, 1/4 cup
B) Regular yogurt, 1 cup
C) Cooked cabbage, 1/2 cup
D) Cooked pinto beans, 1 cup
E) Cooked enriched pasta, 1 cup

34. The iron in meat is how many more times available for absorption in the body than the iron in vegetables and grains?
A) 1 to 2 times
B) 3 to 5 times
C) 6 to 8 times
D) They are equally available.
E) Iron from plant sources is more available.

35. Which of the following DECREASES the body's absorption of iron?
A) Eating meat, poultry, or fish
B) Increased stomach acid
C) Eating very high fiber diets
D) The body's need for iron
E) Eating foods high in vitamin C with the meal

36. A 3 inch diameter orange provides approximately what amount of the current DRI for non-pregnant adults for folate?
A) 3/4
B) 1/2
C) 1/4
D) 1/8
E) 1/16

37. Which of these foods provides the most folate?
A) Orange juice from frozen, 3/4 cup
B) Grape juice from frozen, 3/4 cup
C) Cantaloupe, 1/2 cup
D) Red grapefruit, 1/2
E) Banana, 1 medium

38. Which pair of foods has the most folate? (*Assume standard serving sizes are used*.)
A) Cooked broccoli and cooked corn
B) Cooked kale and iceberg lettuce
C) Fresh spinach and fresh tomato
D) Cooked peas and raw carrots
E) Romaine lettuce and fresh spinach

39. Which of these foods provides the most folate?
A) Tofu, 3 oz.
B) Cooked pinto beans, 1/2 cup
C) Almonds, 1 oz.
D) Hard cooked egg, 1
E) Roasted chicken thigh, 3 oz.

40. Which of these foods provides the most folate?
A) Tortilla chips, 1oz (smallest individual bag)
B) Graham crackers, 2 rectangles
C) Saltine crackers, 5 saltines with 1 oz cheese
D) Popcorn, 3 cups, popped
E) Pretzels, 1oz (smallest individual bag)

41. Folate is added to which of the following foods?
A) Ready-to-eat, enriched breakfast cereal
B) Fortified margarine
C) Iodized salt
D) Fortified skim milk
E) Fortified refrigerated orange juice

42. One cup of skim milk provides about what fraction of the current DRI for calcium for a 21-year-old female?
A) 1/5
B) 1/4
C) 3/10
D) 3/8
E) 1/2

43. Rank the following in order of most to least calcium content:
1) Cheddar cheese, 1 oz
2) Sour Cream, 2 Tbsp.
3) Ice cream, 1 cup
4) Skim milk, 1 cup
5) Cottage cheese, 1/2 cup

A) 4, 1, 3, 5, 2
B) 4, 5, 3, 1, 2
C) 4, 1, 5, 3, 2
D) 1, 4, 5, 2, 3
E) 4, 5, 1, 2, 3

44. Which food supplies the most calcium per kcal?
A) Cheddar cheese, 1 oz
B) Regular strawberry yogurt, 8 oz.
C) Ice cream, 1 cup
D) Skim milk, 1 cup
E) Cottage cheese, 1/2 cup

45. About how much steamed broccoli is needed to obtain the calcium equivalent of 1 cup of skim milk?
A) 2 cups
B) 4 cups
C) 6 cups
D) 8 cups
E) 10 cups

47. A serving of a hot fudge sundae has 200 mg calcium and 500 kcal. What is the INQ for the sundae?
A) .2
B) .8
C) 1.2
D) 2.5
E) 5.0

48. Which of the following statements best describes the meaning of an Index of Nutritional Quality (INQ) of 1.6 for calcium for a serving of a casserole.
A) The casserole is a poor source of calcium for the kcal it provides.
B) The DRI for calcium will be met if one eats enough casserole to provide 500 kcal.
C) The casserole contains a lot of fat.
D) The casserole provides 1.6 mg of calcium for every 100 kcal.
E) The amount of calcium in the casserole per kcal is 1.6 times better than the total diet needs to be in order to supply adequate calcium.

CHANGES FOR INTRODUCTORY POSTTEST

For research data, please fill in all the personal data section of the *Scantron* sheet.

*****Name	*****Grade or Educ (years of education completed)
*****Sex	*****Social security number (optional)
*****Birthdate	<u>******Test form - blacken the letter **D***</u>

*****In the first column of Special Codes, blacken:

Nutrition Majors blacken **1** Non-majors blacken **2**

Number 30 corrected:

30. One 3 oz. serving of cooked lean beef supplies approximately what percent of the RDA <u>*for iron*</u>?
    A) 100%
    B) 75%
    C) 50%
    D) 20%
    E) 10%

47 and 48 numbered correctly:

46. A serving of a hot fudge sundae has 200 mg calcium and 500 kcal. What is the INQ for the sundae?
    A) .2
    B) .8
    C) 1.2
    D) 2.5
    E) 5.0

47. Which of the following statements best describes the meaning of an Index of Nutritional Quality (INQ) of 1.6 for calcium for a serving of a casserole.
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    C) The casserole contains a lot of fat.
    D) The casserole provides 1.6 mg of calcium for every 100 kcal.
    E) The amount of calcium in the casserole per kcal is 1.6 times better than the total diet needs to be in order to supply adequate calcium.

Extra question added to differentiate pre- and posttests; not included in cognitive scores:

<u>*62. Which nutrient needs increase in pregnancy for adult (19-55 years of age) females?*</u>
<u>*A) Iron and calcium*</u>
<u>*B) Iron and folate*</u>
<u>*C) Iron and vitamin A*</u>
<u>*D) Calcium and vitamin A*</u>
<u>*E) Calcium and folate*</u>

MULTIMEDIA PRETEST (for Advanced Nutrition Classes)

For research data, please fill in all the personal data section of the *Scantron* sheet.

*****Name	*****Grade or Educ (years of education completed)
*****Sex	*****Social security number (optional)
*****Birthdate	*****Test form - blacken the letter **A**

*****In the first column of Special Codes, blacken:
Nutrition Majors blacken **1** Non-majors blacken **2**

SECTION I

On the *Scantron* sheet, please mark one of the five responses based on your attitude regarding each statement below.

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   (A) Strongly Agree (B) Agree (C) Neutral
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   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

3. All fruits and vegetables contain approximately the same amount of vitamin A.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

4. A diet without meat is likely to be deficient in iron.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

5. The color of the flesh of a fruit or vegetable is a good indicator of the vitamin A content.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

6. It is easy to eat a diet with adequate amounts of folate.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

7. A diet without meat can easily meet my nutrient needs.
   (A) Strongly Agree (B) Agree (C) Neutral
   (D) Disagree (E) Strongly Disagree

8. Adults do not need to include milk in their diet.
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10. Most people get enough iron in their diet.
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14. I can easily get adequate calcium from my diet without eating dairy products.
    (A) Strongly Agree (B) Agree (C) Neutral
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15. A diet high in calcium is also high in fat.
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    (D) Disagree (E) Strongly Disagree

16. When comparing two or more meals, I am able to select the one that supplies the most calcium.
    (A) Strongly Agree (B) Agree (C) Neutral
    (D) Disagree (E) Strongly Disagree

17. When comparing two or more meals, I am able to select the one that supplies the most folate.
    (A) Strongly Agree (B) Agree (C) Neutral
    (D) Disagree (E) Strongly Disagree

18. When comparing two or more meals, I am able to select the one that supplies the most iron.
    (A) Strongly Agree (B) Agree (C) Neutral
    (D) Disagree (E) Strongly Disagree

19. When comparing two or more meals, I am able to select the one that supplies the most vitamin A.
    (A) Strongly Agree (B) Agree (C) Neutral
    (D) Disagree (E) Strongly Disagree

20. I can look at a food diary and estimate the amount of folate someone has consumed in a day.
    (A) Strongly Agree (B) Agree (C) Neutral
    (D) Disagree (E) Strongly Disagree

21. I can look at a food diary and estimate the amount of calcium someone has consumed in a day.
    (A) Strongly Agree (B) Agree (C) Neutral
    (D) Disagree (E) Strongly Disagree

22. I can look at a food diary and estimate the amount of vitamin A someone has consumed in a day.
    (A) Strongly Agree (B) Agree (C) Neutral
    (D) Disagree (E) Strongly Disagree

23. I can look at a food diary and estimate the amount of iron someone has consumed in a day.
    (A) Strongly Agree (B) Agree (C) Neutral
    (D) Disagree (E) Strongly Disagree

24. I am able to suggest food choices that will increase the amount of vitamin A supplied by a food diary so that it will meet the RDA.
    (A) Strongly Agree (B) Agree (C) Neutral
    (D) Disagree (E) Strongly Disagree

25. I am able to suggest food choices that will increase the amount of iron supplied by a food diary so that it will meet the RDA.
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SECTION 2

On the *Scantron* sheet blacken in the best answer to each question.

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    B) 25%
    C) 50%
    D) 100%
    E) 200%

29. Which of the following foods is the richest source of vitamin A?
    A) Cooked corn, 1/2 cup
    B) Avocado, 1/2 small
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    D) Fresh Bing cherries, 1 cup
    E) Cooked winter squash, 1/2 cup

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    A) Steamed broccoli, 1/2 cup
    B) Cantaloupe, 1/2 cup
    C) Romaine lettuce, 1 cup
    D) Steamed green beans, 1/2 cup
    E) Fortified skim milk, 8 oz.

31. Taking into account the concept of nutrient density, which of the following foods is the best choice to get vitamin A. *(Assume that standard - not reduced fat- recipes have been used.)*
   A) Caesar salad, 2 cup
   B) Spinach lasagna, 4 oz.
   C) Broccoli cheese soup, 1 cup
   D) Spinach salad, 2 cup with 1/2 hard cooked egg and hot bacon dressing
   E) Sweet potato, 1 medium baked with 1 Tbsp. butter

32. Taking into account the concept of nutrient density, which of the following foods is the best choice as a source of vitamin A. *(Assume standard serving sizes and that standard - not reduced fat- recipes have been used.)*
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   E) Cherry cobbler

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   D) Baked pork chop, 3 oz.
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37. Which of the following foods contain three or more milligrams of iron?
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   D) Cooked pinto beans, 1 cup
   E) Cooked enriched pasta, 1 cup

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   C) 6 to 8 times
   D) They are equally available.
   E) Iron from plant sources is more available.

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   A) Eating meat, poultry, or fish
   B) Increased stomach acid
   C) Eating very high fiber diets
   D) The body's need for iron
   E) Eating foods high in vitamin C with the meal

40. A 3 inch diameter orange provides approximately what amount of the current DRI for non-pregnant adults for folate?
A) 3/4
B) 1/2
C) ¼
D) 1/8
E) 1/16

41. Which of these foods provides the most folate?
A) Orange juice from frozen, 3/4 cup
B) Grape juice from frozen, 3/4 cup
C) Cantaloupe, 1/2 cup
D) Red grapefruit, 1/2
E) Banana, 1 medium

42. Which pair of foods has the most folate? (*Assume standard serving sizes are used*.)
A) Cooked broccoli and cooked corn
B) Cooked kale and iceberg lettuce
C) Fresh spinach and fresh tomato
D) Cooked peas and raw carrots
E) Romaine lettuce and fresh spinach

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D) Hard cooked egg, 1
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B) Graham crackers, 2 rectangles
C) Saltine crackers, 5 saltines with 1 oz cheese
D) Popcorn, 3 cups, popped
E) Pretzels, 1oz (smallest individual bag)

45. Folate is added to which of the following foods?
A) Ready-to-eat, enriched breakfast cereal
B) Fortified margarine
C) Iodized salt
D) Fortified skim milk
E) Fortified refrigerated orange juice

46. One cup of skim milk provides about what fraction of the current DRI for calcium for a 21-year-old female?
A) 1/5
B) 1/4
C) 3/10
D) 3/8
E) 1/2

47. Rank the following in order of most to least calcium content:
1) Cheddar cheese, 1 oz
2) Sour Cream, 2 Tbsp.
3) Ice cream, 1 cup
4) Skim milk, 1 cup
5) Cottage cheese, 1/2 cup

A) 4, 1, 3, 5, 2
B) 4, 5, 3, 1, 2
C) 4, 1, 5, 3, 2
D) 1, 4, 5, 2, 3
E) 4, 5, 1, 2, 3

48. Which food supplies the most calcium per kcal?
A) Cheddar cheese, 1 oz
B) Regular strawberry yogurt, 8 oz.
C) Ice cream, 1 cup
D) Skim milk, 1 cup
E) Cottage cheese, 1/2 cup

49. About how much steamed broccoli is needed to obtain the calcium equivalent of 1 cup of skim milk?

A) 2 cups
B) 4 cups
C) 6 cups
D) 8 cups
E) 10 cups

50. A serving of a hot fudge sundae has 200 mg calcium and 500 kcal. What is the INQ for the sundae?

A) .2
B) .8
C) 1.2
D) 2.5
E) 5.0

51. Which of the following statements best describes the meaning of an Index of Nutritional Quality (INQ) of 1.6 for calcium for a serving of a casserole.

A) The casserole is a poor source of calcium for the kcal it provides.
B) The DRI for calcium will be met if one eats enough casserole to provide 500 kcal.
C) The casserole contains a lot of fat.
D) The casserole provides 1.6 mg of calcium for every 100 kcal.
E) The amount of calcium in the casserole per kcal is 1.6 times better than the total diet needs to be in order to supply adequate calcium.

Continued on next page

This last set of questions gives the breakfast, lunch and snack for a person and a list of possible dinners. Select the dinner that allows the person to meet the nutrient needs specified. On the *Scantron* sheet, blacken the letter for the meal you select. For each of these questions assume standard portion sizes unless otherwise indicated.

52. Select the dinner that will allow Robert, a 30 year old male, to meet the DRI for FOLATE *and* CALCIUM. He had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
Fortified Cereal	Cheeseburger	Bagel
Skim Milk	French Fries	Cream Cheese
Grapefruit	Cola	

DINNER CHOICES:

(A)	(B)	(C)
Bean and Cheese Nachos	Meatloaf	Tuna Melt
Crispy Beef Taco	Mashed Potatoes	(Rye Bread,
Iced tea	Steamed Broccoli	Tuna Salad
	Coffee	Swiss cheese
		Corn Chips
		Iced tea

(D) All meet the needs

(E) None meet the needs

53. Select the dinner that will allow Mary, an 18 year old female, to meet the DRI for FOLATE *and* CALCIUM. She had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
Peanut Butter Sandwich on Enriched Bread	Cheeseburger	Cheddar Cheese
Banana	French Fries	Apple
2% Milk	Cola	

DINNER CHOICES:

(A)	(B)	(C)
Grilled Shrimp (6 oz)	Meatloaf (3 oz)	BBQ Chicken
Romaine Salad	Romaine Salad	Romaine Salad
Steamed Asparagus	Steamed Carrots	Steamed Broccoli
Ice Cream Sundae	Chocolate Malt	Fresh Orange Juice
Coffee		

(D) All meet the needs

(E) None meet the DRI

54. Select the dinner that will allow Danielle, a 25 year old female, to meet the RDA for VITAMIN A *and* IRON. She had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
2 Poached Eggs	Chef Salad including	Apple
2 Slices Bacon	2 cups Romaine,	Nonfat Yogurt
Skim Milk	Tomatoes Carrot Strips	
Pink Grapefruit	1 oz each: Ham, Turkey, Cheese	
	Crackers	
	Lemonade	

DINNER CHOICES:

(A)	(B)	(C)
Fried Clams (5 oz)	Fried Shrimp (5 oz)	Grilled Salmon (6 oz)
Baked Potato with Cheese & Butter	Coleslaw	Spinach Salad
Caesar Salad	French Fries	Seasoned Rice
Chocolate Cake	Chocolate Milk Shake (10 oz)	Iced tea
Cola		

(D)
All meet the needs

(E)
None meet the needs

55. Select the dinner that will allow Ross, a 19 year old male, to meet the RDA for VITAMIN A *and* the DRI for FOLATE. He had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
Peanut Butter on English Muffin	Ham and Cheese Sandwich on Whole Wheat	Glazed Donuts (2)
Skim Milk	Potato Chips	Peach
	Vegetable Soup	
	Iced tea	

DINNER CHOICES:

(A)	(B)	(C)
Spaghetti with Meat sauce	Chef Salad (2 cups Romaine and Iceberg plus, 1 oz each: turkey, cheddar, ham one egg carrot strips, avocado and tomato)	Beef Tenderloin (6 oz)
Caesar Salad	Crackers	Baked Potato with 1 tsp butter
Lemon Ice	Lemonade	Steamed Broccoli with 1 tsp butter
Iced tea		Pumpkin Pie
		Coffee

(D)
All meet the needs

(E)
None meet the needs

56. Select the dinner that will allow Carrie, a 20 year old female, to meet the RDA for VITAMIN A *and* the DRI for FOLATE. She had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
Enriched Toast	Crispy Beef Taco	Peanut Butter on White Bread
Apricots	Beef and Bean Burrito	Skim Milk
Nonfat Yogurt	Apple	
	Cola	

DINNER CHOICES:

(A)	(B)	(C)
Pork Chop	Grilled Salmon Steak	Vegetable Bean Soup
Spinach Salad	Romaine Salad	Caesar Salad (2 cups)
Green Beans	Steamed Summer Squash	Grilled Chicken Breast
Corn Bread	Enriched Dinner Roll	Garlic Toast

(D) All meet the needs

(E) None meet the needs

57. Select the dinner that will allow Lisa, a 19 year old female, to meet the RDA for IRON *and* the DRI for CALCIUM. She had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
Regular Yogurt	2 Slices Pepperoni Pizza	Orange
Strawberries	Romaine and Iceberg Salad	Chocolate Chip Cookies
Whole Wheat Toast	Orange Soda	
Coffee		

DINNER CHOICES:

(A)	(B)	(C)
Beef Stew	Grilled Chicken Breast	Sweet & Sour Pork
Cornbread	Steamed Asparagus	Steamed Rice
Cola	Zucchini	Won Ton Soup
	Seasoned Rice	Iced tea
	Iced tea	

(D) All meet the needs

(E) None meet the needs

58. Select the dinner that will allow Tiffany, an 18 year old female, to meet the RDA for IRON *and* VITAMIN A. She had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
Whole Wheat Toast	Chicken Breast	Nonfat Yogurt
Cantaloupe	Romaine Salad (1 ½ cups)	Apple
Skim Milk	Tomato, Cucumber, Radish (½ cup total)	
	Enriched roll	
	Iced tea	

DINNER CHOICES:

(A)	(B)	(C)
Pork loin (5 oz)	Roast Beef (5 oz)	Pinto Beans (1 cup)
Buttered Green Peas	Spinach Salad	Rice (1 cup)
Mashed Potatoes	Baked Potato with Cheese and Butter	Romaine Salad
Pumpkin Pie	Buttered Broccoli	Sunflower Seeds
Coffee	Pecan Pie	Cornbread
	Coffee	Apple Pie
		Coffee

(D) All meet the needs

(E) None meet the needs

59. Select the dinner that will allow Julie, a 32 year old female, to meet the RDA for IRON *and* DRI for CALCIUM. She had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
Fortified Toasted Oats Cereal	Open Faced Tuna Salad on Whole Wheat	Regular Yogurt
Banana	Grapes	Graham Cracker
Skim Milk	Onion Soup	
Fresh Orange Juice	Diet cola	

DINNER CHOICES:

(A)	(B)	(C)
Spaghetti with Marinara Sauce	Beef Enchilada	Chicken Vegetable Stir Fry
Tossed Salad (Romaine, Tomato, Carrot)	Guacamole Salad (1/2 cup)	Egg Drop Soup
Garlic Toast	Tortilla Chips (4 oz)	Tea
Iced tea	Cola	

(D) All meet the needs

(E) None meet the needs

60. Select the dinner that will allow Kirk, a 20 year old male, to meet the RDA for IRON *and* VITAMIN A *and* the DRI for CALCIUM a*nd* FOLATE. He had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
Regular (non-fortified) Oatmeal	Meat & Veggie Pizza (2 slices)	Regular Yogurt
Skim Milk	Romaine Salad	Orange
Cantaloupe	Garlic Toast and Soda	

DINNER CHOICES:

(A)	(B)	(C)
Beef Chili with Beans	Grilled Shrimp (6 oz)	Cheeseburger (1/4 pound)
Cornbread	Iceberg Salad	French Fries
Romaine Salad	Steamed Asparagus	Orange Juice from Frozen
Cola	Enriched Dinner Roll	
	Iced tea	

(D) All meet the needs

(E) None meet the needs

61. Select the dinner that will allow Andrew, a 27 year old male, to meet the RDA for VITAMIN A *and* IRON *and* the DRI for CALCIUM a*nd* FOLATE. He had the following for Breakfast, Lunch and Snack:

BREAKFAST	LUNCH	SNACK
Poached Eggs (2)	Roast Beef Sandwich on a Submarine Roll with Lettuce and Tomato	Banana
Whole Wheat Toast With Margarine	Vegetable Soup	Skim Milk
Calcium Fortified Orange Juice	Potato Chips	
	Iced tea	

DINNER CHOICES:

(A)	(B)	(C)
Combination Fried Rice With 1 cup Rice, Egg, Beef, Chicken, Shrimp, Peas and Soy Sauce	Tortilla Soup	Tomato Basil Cream Soup
Iced tea	Beef Fajita Salad With 1 cup Romaine, Tomato, Avocado, Cheese and Tortilla Chips	Chicken Parmesan (Breaded Baked, Chicken Breast)
	Iced tea	Iced tea

(D) All meet the needs

(E) None meet the needs

CHANGES FOR ADVANCED POSTTEST

For research data, please fill in all the personal data section of the *Scantron* sheet.

*****Name
*****Sex
*****Birthdate
*****Grade or Educ (years of education completed)
*****Social security number (optional)
*<u>*****Test form - blacken the letter **C**</u>*
*****In the first column of Special Codes, blacken:

Nutrition Majors blacken **1** Non-majors blacken **2**

Number 30 corrected:

34. One 3 oz. serving of cooked lean beef supplies approximately what percent of the RDA *<u>for iron</u>*?
    A) 100%
    B) 75%
    C) 50%
    D) 20%
    E) 10%

Extra question to differentiate pre- and posttests; not included in cognitive scores:

<u>62. Which nutrient needs increase in pregnancy for adult (19-55 years of age) females?</u>
<u>A) Iron and calcium</u>
<u>B) Iron and folate</u>
<u>C) Iron and vitamin A</u>
<u>D) Calcium and vitamin A</u>
<u>E) Calcium and folate</u>

Appendix E

Preceptor Instructions and Feedback Questionnaire

Instructions for Measurement Instruments for *SmartBytes* Program
Experimental Groups

The package of materials for collecting data to be used with the *SmartBytes* Program includes:

Pretest (Introductory classes in white- Medical Nutrition Therapy in yellow)
Posttest (same color code)
Scantron Sheets
Floppy disks (IBM compatible) for **Introductory classes only**
SmartBytes CDs (10) containing the program (IBM compatible)

- Please administer the pretest to your classes during the first weeks of the semester – preferably before the nutrients of calcium, folate, iron or vitamin A have been covered in class.

- During the same time period, please have the introductory students save1-day dietary record to disk the using the program they are using to complete any course dietary analysis assignment. In the absence of an assignment, please have them the save to disk a 24-hour food record using whatever software is available on your campus. They should save in that program's format, not as a Word document. If by chance you do not have a dietary analysis software program available, please have them type up a 24-hour record and save it on the floppy disk in Microsoft Word for the PC. Word should only be used if there is no dietary analysis program available. Specific instructions for the diet recall are at the end of these instructions and will be e-mailed for electronic distribution.

PLEASE HAVE THEM WRITE THEIR NAMESON THE FLOPPY DISK!
It will be used for a second recall after the posttest.

- Please return the pretest scantron sheets in the postage paid envelope after the pretests have been administered. The students will keep the floppy disks to use for collection of a 24-hour record in conjunction with the posttest.

- **Please allow at least four weeks before administering the posttest.**

- At the same time, have the students use their floppy disk to collect a second 1-day food record.

Please have the students use this code when saving their dietary records:
For the pretest --- DAY1 (their 3 initials)
For the postest – DAY2 (their 3 initials)

- When you have all of this information, please return it in the postage paid envelope mailer. Please return the floppy disks (with both pre- and posttest information) in the other postage paid envelope or box we have supplied, separately from the posttests.

  We have covered the cost of a delivery confirmation receipt for the materials when they are mailed. Please ask the person handling your mail to get it to the post office to activate this confirmation process.

THANK YOU SO MUCH FOR YOUR PARTICIPATION
IN OUR RESEARCH!

INSTRUCTIONS FOR SECOND DIET RECALL

- Use the same *SmartBytes* floppy disk that you used for your first diet recall. You may use any dietary analysis program you use for your nutrition class

- List all foods and beverages consumed.
-
- List portion sizes.
-
- Be detailed when entering information.

  For example – DO SAY: 1 cup Corn Flakes with ½ cup whole milk and banana

  DO NOT SAY: cereal with milk and fruit

- Save your 24-hour recall in the program form. Do not save it as a Word file or copy your list to Word.

- Save your recall as DAY**2** plus your initials.

Instructions for Measurement Instruments for *SmartBytes* Program
Control Groups

The package of materials for collecting data to be used with the *SmartBytes* Program includes:

Pretest (Introductory classes in white- Medical Nutrition Therapy in yellow)
Posttest (same color code)
Scantron Sheets
Floppy disks (IBM compatible) for **Introductory classes only.**

- Please administer the pretest to your classes during the first weeks of the semester – preferably before the nutrients of calcium, folate, iron or vitamin A have been covered in class.

- During the same time period, please have the introductory students save1-day dietary record to disk the using the program they are using to complete any course dietary analysis assignment. In the absence of an assignment, please have them the save to disk a 24-hour food record using whatever software is available on your campus. They should save in that program's format, not as a Word document. If by chance you do not have a dietary analysis software program available, please have them type up a 24-hour record and save it on the floppy disk in Microsoft Word for the PC. Word should only be used if there is no dietary analysis program available. Specific instructions for the diet recall are at the end of these instructions and will be e-mailed for electronic distribution.

PLEASE HAVE THEM WRITE THEIR NAMESON THE FLOPPY DISK!
It will be used for a second recall after the posttest.

- Please return the pretest scantron sheets in the postage paid envelope after the pretests have been administered. The students will keep the floppy disks to use for collection of a 24-hour record in conjunction with the posttest.

- **Please allow at least four weeks before administering the posttest.**

- At the same time, have the students use their floppy disk to collect a second 1-day food record.

Please have the students use this code when saving their dietary records:

For the pretest --- DAY1 (their 3 initials)
For the postest – DAY2 (their 3 initials)

- When you have all of this information, please return it in the postage paid envelope mailer. Please return the floppy disks (with both pre- and posttest information) in the other postage paid envelope or box we have supplied, separately from the posttests.

  We have covered the cost of a delivery confirmation receipt for the materials when they are mailed. Please ask the person handling your mail to get it to the post office to activate this confirmation process.

THANK YOU SO MUCH FOR YOUR PARTICIPATION
IN OUR RESEARCH!

INSTRUCTIONS FOR SECOND DIET RECALL

- Use the same *SmartBytes* floppy disk that you used for your first diet recall. You may use any dietary analysis program you use for your nutrition class

- List all foods and beverages consumed.
-
- List portion sizes.
-
- Be detailed when entering information.

  For example – DO SAY: 1 cup Corn Flakes with ½ cup whole milk and banana

  DO NOT SAY: cereal with milk and fruit

- Save your 24-hour recall in the program form. Do not save it as a Word file or copy your list to Word.

- Save your recall as DAY**2** plus your initials.

INFORMATION FOR USE OF *SMARTBYTES* PROGRAM

The program is on the CDs you have received.

The program will work best if it is copied from the CD to the computer hard drive. To do this -- go to the CD drive – when you see the program copy it – then move to the desktop (or desired folder) and paste. Please set the monitor to 16 bit High Color or better. Lower settings will distort the images in the program.

We suggest that you have the program put onto multiple computers in your computer lab if possible. In addition, you may allow students to copy the program to use on their personal computers if you would like. The program will fit onto CD or 250MB Zip disks. You have our permission to burn additional copies of the program for your students if your lab has that capability.

The program includes information that will allow the student to learn how to move through the program in order to get the most from it. We hope they will not require additional information in order to effectively use the program.

THANK YOU SO MUCH FOR YOU PARTICIPATION IN OUR RESEARCH!

INTRODUCTORY POSTTEST FEEDBACK FORM

Please mark on the **Scantron sheet**, one of the five responses closest to your attitude regarding each statement below.

49. I found the instructions for using the *SmartBytes* were:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

50. I found the *SmartBytes* section on vitamin A:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

51. I found the *SmartBytes* section on iron:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

52. I found the *SmartBytes* section on folate:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

53. I found the *SmartBytes* section on calcium:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

54. When added to the regular coursework, how will *SmartBytes* affect your ability to do a better job of selecting a diet that supplies the recommended amount of calcium, iron, vitamin A and folic acid?

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

55. I found the *SmartBytes* section on learning nutrient requirements:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

56. I found the *SmartBytes* section on learning nutrient sources:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

57. I found the *SmartBytes* section on learning nutrient density and bioavailability concepts:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

58. I found the *SmartBytes* section on analyzing menus:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

59. I found the *SmartBytes* section on analyzing dietary records:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

60. I found the audio in *SmartBytes*:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

62. I found the activities in *SmartBytes*:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

63. I found the feedback in *SmartBytes*:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

64. I found the tools (e.g., tables, definitions) in *SmartBytes*:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

For questions 65-68 please rank class lecture, class text, dietary analysis activity, and *SmartBytes* for their value in learning food composition. Each choice may be used only once.

65. Class text _____

66. Class lectures/discussions _____

67. *SmartBytes* _____

68. Diet analysis activity _____

(A) The most helpful
(B) The second most helpful
(C) The third most helpful
(D) The least helpful

69. About how much time did you spend working on the calcium module of *SmartBytes*:

(A) <30 minutes	(B) 30-45 minutes	(C) 45-60 minutes
(D) 60-90 minutes	(E) >90 minutes	

70. About how much time did you spend working on the folate module of *SmartBytes*:

(A) <30 minutes	(B) 30-45 minutes	(C) 45-60 minutes
(D) 60-90 minutes	(E) >90 minutes	

71. About how much time did you spend working on the iron module of *SmartBytes*:

(A) <30 minutes	(B) 30-45 minutes	(C) 45-60 minutes
(D) 60-90 minutes	(E) >90 minutes	

72. About how much time did you spend working on the vitamin A module of *SmartBytes*:

(A) <30 minutes	(B) 30-45 minutes	(C) 45-60 minutes
(D) 60-90 minutes	(E) >90 minutes	

On the back of the **Scantron sheet**, please answer the following questions:

73. One important thing I learned from *SmartBytes* was:

74. One thing I wish I had learned from *SmartBytes* was:

75. Additional comments:
(Use the rest of this sheet if there is not enough space on the **Scantron sheet**.)

ADVANCED POSTTEST FEEDBACK FORM

Please mark on the **Scantron sheet**, one of the five responses closest to your attitude regarding each statement below.

63. I found the instructions for using the *SmartBytes* were:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

64. I found the *SmartBytes* section on vitamin A:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

65. I found the *SmartBytes* section on iron:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

66. I found the *SmartBytes* section on folate:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

67. I found the *SmartBytes* section on calcium:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

68. When added to the regular coursework, how will *SmartBytes* affect your ability to do a better job of selecting a diet that supplies the recommended amount of calcium, iron, vitamin A and folic acid?

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

69. When added to the regular coursework, how will *SmartBytes* affect your ability to do a better job of analyzing diet histories for calcium, iron, vitamin A and folic acid?

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

70. I found the *SmartBytes* section on learning nutrient requirements:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

71. I found the *SmartBytes* section on learning nutrient sources:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

72. I found the *SmartBytes* section on learning nutrient density and bioavailability concepts:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

73. I found the *SmartBytes* section on analyzing menus:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

74. I found the *SmartBytes* section on analyzing dietary records:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

75. I found the audio in *SmartBytes*:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

76. I found the activities in *SmartBytes*:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

77. I found the feedback in *SmartBytes*:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

78. I found the tools (e.g., tables, definitions) in *SmartBytes*:

(A) Very helpful	(B) Helpful	(C) Neutral
(D) Not very helpful	(E) Not helpful	

For questions 79-82 please rank class lecture, class text, dietary analysis activity, and *SmartBytes* for their value in learning food composition. Each choice may be used only once.

79. Class text _____

80. Class lectures/discussions _____

81. *SmartBytes* _____

82. Diet analysis activity _____

(A) The most helpful
(B) The second most helpful
(C) The third most helpful
(D) The least helpful

83. About how much time did you spend working on the calcium module of *SmartBytes*:

(A) <30 minutes (B) 30-45 minutes (C) 45-60 minutes
(D) 60-90 minutes (E) >90 minutes

84. About how much time did you spend working on the folate module of *SmartBytes*:

(A) <30 minutes (B) 30-45 minutes (C) 45-60 minutes
(D) 60-90 minutes (E) >90 minutes

85. About how much time did you spend working on the iron module of *SmartBytes*:

(A) <30 minutes (B) 30-45 minutes (C) 45-60 minutes
(D) 60-90 minutes (E) >90 minutes

86. About how much time did you spend working on the vitamin A module of *SmartBytes*:

(A) <30 minutes (B) 30-45 minutes (C) 45-60 minutes
(D) 60-90 minutes (E) >90 minutes

On the back of the **Scantron sheet**, please answer the following questions:

87. One important thing I learned from *SmartBytes* was:

88. One thing I wish I had learned from *SmartBytes* was:

89. Additional comments:
(Use the rest of this sheet if there is not enough space on the **Scantron sheet**.)

Appendix F

Program Development Feedback Forms

Fall 1997, Multi-media Module Evaluation

1 How often do you use multi-media programs?	daily	weekly	monthly	rarely	never
2 How easy was this program to use:					
Pretest	very easy	easy	about right	difficult	too difficult
Pyramid sections	very easy	easy	about right	difficult	too difficult
RDA sections	very easy	easy	about right	difficult	too difficult
Sources sections	very easy	easy	about right	difficult	too difficult
Nutrient density sections	very easy	easy	about right	difficult	too difficult
Comments:					
3 How much time did this program take:					
Vitamin A	<30 min.	<45 min.	<60 min.	<1 1/2 hrs	>2 hrs
Folate	<30 min.	<45 min.	<60 min.	<1 1/2 hrs	>2 hrs
Pretest	<30 min.	<45 min.	<60 min.	<1 1/2 hrs	>2 hrs
4 How helpful to learning were the activities:					
click and drag	very good	good	ok	poor	confusing
multiple choice	very good	good	ok	poor	confusing
type in your answer	very good	good	ok	poor	confusing
number ranking	very good	good	ok	poor	confusing
5 How helpful to learning were the sections:					
Pyramid	very good	good	ok	poor	confusing
RDA	very good	good	ok	poor	confusing
Sources	very good	good	ok	poor	confusing
Nutrient Density	very good	good	ok	poor	confusing
Help section (leave blank if didn't use)	very good	good	ok	poor	confusing
Tables section (leave blank if didn't use)	very good	good	ok	poor	confusing
6 How easy was it to move within the program?	very easy	easy	about right	difficult	too difficult

7 How helpful were:	very good	good	ok	poor	confusing
food pictures	very good	good	ok	poor	confusing
sound effects (more to be added)	very good	good	ok	poor	confusing
Activities	very good	good	ok	poor	confusing
Objectives	very good	good	ok	poor	confusing
end of section questions	very good	good	ok	poor	confusing

8 Please add any comments to improve the program.

Preceptor Questionnaire

1. Are you willing to participate in the project?______Yes ______No

2, If yes, will you or any of your participating colleagues be able to review the folate module in a formative education mode in May and/or early June? Target ship date is May 10 with a target return of comments by June 15.

   ________________Yes ______No

3. If so, do you need Mac or PC format in a CD or do you need a Zip disk?

   ________________Zip ______CD ______PC ______Mac

4. Will you/your school participate in the ______Introductory Course?

   ______MNT?

   ______Both?

   If possible, we would like 30 to 50 students from each level. However, we will work with whatever numbers you can recruit.

5. Assuming that you are willing to participate, what text is being used in your Introductory Nutrition course? ____

6. Is a diet analysis assigned as a part of the introductory course? If so, what software is used for the analyses?____

Preceptor Feedback

Thank you for taking the time to review this part of our program. The complete program will include similar information on vitamin A, calcium and iron. Your feedback will allow us to know if the program is comfortable to use and if we are focusing on the right type of information. As you answer these questions, please feel free to give us your feedback – both positive and negative – as well as other thoughts you think will be helpful as we complete this "work in progress".

Navigating the program

Were you able to move through the program without trouble?

Yes   No - Please identify what caused you the most trouble.

Were the following helpful? Note: The "You Are Here" map is intended to reflect where the user is in the program, and which sections were completed when all sections of the program are completed.

Folate Menu	Yes	No
Top pulldown menu bar	Yes	No
Calculator	Yes	No
Nurtient Tables	Yes	No
Servings	Yes	No
Definitions	Yes	No

Comments:

How much time did it take you to complete the sections?

________________Pretest   Comments:

________________DRI

________________Pyramid

________________Sources

________________Nutrient Density

________________Applications

Was the amount of time to complete the program appropriate for students?
Note: The completed program will have the pretest, posttest and nutrient modules (folate, vitamin A, calcium and iron).

Yes   No - please comment:

(Optional) Do you consider yourself:

_____A computer novice (some experience with spreadsheets/word processing).
_____Somewhat experienced (at ease with spreadsheets/word processing, or other programs or limited multimedia experience)
_____Experienced (easily use multimedia programs)

Content

How was the scope of information? Please supply specific details that would be helpful.

DRI/RDA	Too Broad	About Right	Too Limited
Servings to meet 100 mcg	Too Broad	About Right	Too Limited
Figure 100 mcg servings	Too Broad	About Right	Too Limited
Pyramid	Too Broad	About Right	Too Limited
Sources	Too Broad	About Right	Too Limited
Nutrient Density	Too Broad	About Right	Too Limited
Processing	Too Broad	About Right	Too Limited
Fortification	Too Broad	About Right	Too Limited
INQ	Too Broad	About Right	Too Limited
mcg/kcal	Too Broad	About Right	Too Limited
mcg/100 g	Too Broad	About Right	Too Limited
Math Help	Too Broad	About Right	Too Limited
Applications	Too Broad	About Right	Too Limited
Mixed Dishes	Too Broad	About Right	Too Limited
Which meal has the most folate	Too Broad	About Right	Too Limited
Eating Out	Too Broad	About Right	Too Limited
Diet History	Too Broad	About Right	Too Limited

Please rank the importance of each of the sections. 1 is most important, 5 the least.

____ DRI   Comments:

____Pyramid

____Sources

____Nutrient Density

____Applications

What sections you would eliminate? Why (if not explained above)?

What additional information would you include?

Did you find any inaccurate information in the program?
No   Yes - please give details:

Were explanations concise yet understandable?
Yes   No - please explain:

What was your favorite activity?

What activity did you like the least?

Was the variety of activities to be sufficient?
Yes   No - please give suggestions:

Were the examples used helpful and appropriate?
Yes   No - please explain:

What did you find unhelpful or confusing in the program?

Do you think the students will get value for the time spent on the program?

Yes   No - please explain:

Please list any other suggestions you have for improving the program.

Finally, we would like to take advantage your knowledge if we can! During the writing of our program we discovered some nutrient compostion information that we are at a loss to explain. Does anyone out there know 1) why canned pumpkin is so much higher in vit A than raw pumpkin (condensation doesn't seem to explain it) 2) Why French fries have so much more folate than a raw potato? 3) Why potato chips have so much more folate than a potato? 4) Why clams have such a high iron content?

Appendix G

Matrix of Objectives

Objective	Question[a]	Category[b]	Program Activity
CALCIUM			
Identify the DRI as 1000 mg for calcium for a non-pregnant adult.	42/46. One cup of skim milk provides about what fraction of the current DRI for calcium for a 21-year-old DRI?	Knowledge	Fill-in-the-blank Drag amount to target person
Identify milligrams as the units of measure for calcium.			Fill-in-the-blank
Identify foods that contain at least 300 mg calcium in a single serving.			Drag-to-plate Select from menus
Choose 3-6 foods that, when combined, meet 50% of the DRI for calcium.			Drag-to-plate Select from menus, or diet history suggestions
Identify milk as the key food source for calcium.			Fill-in-the-blank
Identify the calcium content of milk as 300 mg for 8 oz.	42/46. One cup of skim milk provides about what fraction of the current DRI for calcium for a 21-year-old DRI?	Knowledge	Fill-in-the-blank,
Identify that milk has 30% of the DRI for calcium.			Fill-in-the-blank
Identify calcium sources meeting at least 30% of the DRI per serving.			Drag-to-plate, Select from menus or diet history
Identify calcium sources providing 5% of the DRI per serving.			Drag-to-plate, Select from menus, diet history, or select the meal
Rank foods by calcium content, relative to the key food.	43/47. Rank the following in order of most to least calcium content.	Application	Drag in order of content
	44/48 Which food supplies the most calcium.		

[a] Question number from introductory/advanced instruments
[b] Cognitive domain category of questions for knowledge, application,, or analysis

Objective	Question[a]	Category[b]	Program Activity
Identify the effects of fortification and bioavailability on calcium content.			Drag-to-plate, Select from menus, diet history, or select the meal
Calculate the INQ for calcium of a given food.	46/50. A serving of hot fudge has 200 mg calcium and 500 kcal. What is the INQ for the sundae?	Application	Multiple choice questions
Rank foods according to nutrient density for calcium.			Rank and select foods.
Choose the meal highest in calcium from a given selection.	52, 53, 57, 59, 60, 61 Select the dinner that allows the person to meet the nutrient needs specified.	Analysis	Select a meal
Identify the approximate percentage of the DRI for calcium from a diet history.			Diet history multiple choice
Based on client recall, identify at least 2 ways to increase the intake of calcium to meet 90% of the DRI.			Diet history type in suggestions
Identify components of mixed dishes and estimate the calcium content of the dish.			Mixed dishes multiple choice
Select a meal that meets 50% of the DRI for calcium from a restaurant menu.			Select from menu
FOLATE Identify the DRI for folate for an adult as 4000 µg.	36/40. A 3-inch diameter orange provides approximately what amount of the current DRI for non-pregnant adults for folate DRI?	Knowledge	Fill-in-the-blank Drag amount to target person
Recognize there is an increase in the DRI for folate for pregnancy.			Drag amount to target person

[a] Question number from introductory/advanced instruments
[b] Cognitive domain category of questions for knowledge, application,, or analysis

Objective	Question[a]	Category[b]	Program Activity
Identify the units of measure for folate as micrograms.			Fill-in-the-blank
Identify foods that contain at least 100 µg folate in a single serving.			Drag-to-plate Select from menus
Identify the orange as the key food source for folate**.**			Fill-in-the-blank
Identify 50 µg as the folate content of a three-inch orange.	36/40. A 3-inch diameter orange provides approximately what amount of the current DRI for non-pregnant adults for folate DRI?	Knowledge	Fill-in-the-blank
Identify that the orange has more than 10% of the DRI for folate.	36/40. A 3-inch diameter orange provides approximately what amount of the current DRI for non-pregnant adults for folate DRI?	Knowledge	Fill-in-the-blank
Identify "good" folate sources providing 10% of the DRI per serving.			Drag-to-plate, Select from menus or diet history
Identify folate sources meeting at least 5% of the DRI per serving.	37/41, 38/42, 39/43, 40/44. Which of these foods provides the most folate?	Knowledge	Drag-to-plate, Select from menus, diet history, or select the meal
Rank foods by folate content, relative to the key food.			Drag in order of content
Identify processing and preparation methods that decrease the folate content of foods.			Drag-to-plate, Select from menus, diet history, or select the meal
Identify which foods are enriched with folate.	41/45. Folate is added to which of the following foods	Knowledge	Multiple choice

[a] Question number from introductory/advanced instruments
[b] Cognitive domain category of questions for knowledge, application,, or analysis

Objective	Question[a]	Category[b]	Program Activity
Calculate the INQ for folate of a given food. Rank foods according to nutrient density for folate.			Multiple choice questions Rank and select foods.
Choose the meal highest in folate from a given selection. Identify the approximate percentage of the DRI for folate from a diet history. Based on client recall, identify at least 2 ways to increase the intake of folate to meet 90% of the DRI. Identify components of mixed dishes and estimate the folate content of the dish. Select a meal that meets 50% of the DRI for folate from a restaurant menu.	52, 53, 55, 56, 60, 61 Select the dinner that allows the person to meet the nutrient needs specified .	Analysis	Select a meal Diet history multiple choice Diet history type in suggestions Mixed dishes multiple choice Select from menu

[a] Question number from introductory/advanced instruments
[b] Cognitive domain category of questions for knowledge, application,, or analysis

Table 21 Classification of cognitive items by nutrient and Bloom's Taxonomy

Nutrient	Knowledge	Application	Analysis
Introductory			
Calcium	42	43,44,45,46,47	
Folate	36,37,38,39,40,41		
Iron	30,33,34,35	31,32	
Vitamin A	24,25,26,29	27,28	
Advanced			
Calcium	46	47,48,49,50,51,	52,53,57,59,60,61
Folate	40,41,42,43,44,45		52,53,55,56,60,61
Iron	34,37,38,39	35,36	54,57,58,59,60,61
Vitamin A	28,29,30,33	31,32	54,55,56,58,60,61

Appendix H

Tables for Chapter 4: Results

Table 22 Number of subjects and frequencies of selected demographic characteristics of subjects enrolled in introductory nutrition classes by location

Location/Group		**Total**	**Gender**		**Major**		**Age (years)**			**Years education**				
			Male	**Female**	**Nutrition**	**Other**	**<20**	**20-24**	**>24**	**<13**	**13**	**14**	**15**	**16**
		n	n	n	n	n	n	n	n	n	n	n	n	n
AR	TC[a]	54[b]	6	47	4	30	18	35	1	-	3	8	7	9
DE	TC	52	6	46	3	46	40	10	1	-	12	14	2	2
FL	TC	18	4	14	1	16	8	6	3	-	3	4	5	1
TX	TC	86	21	59	13	60	48	27	3	3	11	15	11	8
Total	**TC**	**210**	**37**	**166**	**21**	**152**	**114**	**78**	**8**	**3**	**27**	**41**	**25**	**20**
AR	IMM	48	19	29	3	34	24	22	2	-	5	12	11	10
CA	IMM	14	2	12	-	13	2	6	6	-	1	1	5	6
DE	IMM	22	2	20	-	22	19	2	1	1	7	7	-	1
FL	IMM	24	4	20	1	23	12	12	-	-	2	7	5	2
IN	IMM	35	-	-	21	14	-	-	-	-	1	15	12	7
OK	IMM	28	10	18	1	24	10	18	-	1	1	6	12	8
TX	IMM	37	3	34	29	6	19	17	1	4	5	9	6	5
Total	**IMM**	**208**	**40**	**131**	**55**	**138**	**86**	**77**	**10**	**6**	**22**	**57**	**51**	**39**

[a] Traditional curriculum (TC), IMM enhanced (IMM)
[b] Numbers for subsets of characteristics may not equal total number of subjects because some subjects omitted information

Table 23 Number of subjects and frequencies of selected demographic characteristics of subjects enrolled in advanced nutrition classes by location

Location/Group		**Total**	**Gender**		**Major**		**Age (years)**		**Years education**		
			Male	**Female**	**Nutrition**	**Other**	**20-24**	**>24**	**15**	**16**	**>16**
		n	n	n	n	n	n	n	n	n	n
IA	TC[a]	17[b]	1	15	15	1	13	2	1	10	-
IN	TC	24	-	24	24	-	22	2	1	19	-
TX	TC	19	2	11	11	2	10	2	-	5	-
Total	**TC**	**60**	**3**	**50**	**50**	**3**	**45**	**6**	**2**	**34**	**-**
DE	IMM	24	2	22	24	-	21	3	12	7	-
FL	IMM	20	8	12	19	1	11	9	6	6	1
IA	IMM	25	1	23	23	2	18	6	4	14	1
IN	IMM	18	1	17	17	-	15	3	3	12	-
OK	IMM	24	5	18	20	3	19	4	3	10	-
TX	IMM	11	-	11	11	-	8	3	2	4	1
Total	**IMM**	**122**	**17**	**103**	**114**	**6**	**92**	**28**	**30**	**53**	**3**

[a] Traditional curriculum (TC), IMM enhanced (IMM)
[b] Numbers for subsets of characteristics may not equal total number of subjects because some subjects omitted information

Table 24 Mean cognitive total and subset scores for students enrolled in introductory nutrition classes

Test items	Knowledge scores TC[a]	IMM	p[b]
	Mean ± standard deviation		
21 Pretest cognitive items	6.5±2.2	7.0±2.6	.037
21 Posttest cognitive items	7.8±2.8	9.4±3.7	<.001
14 Pretest knowledge items	4.5±1.7	4.8±1.8	.153
14 Posttest knowledge items	5.2±2.1	6.2±2.6	<.001
7 Pretest application items	2.0±1.2	2.2±1.4	.062
7 Posttest application items	2.6±1.3	3.2±1.6	<.001
4 Pretest calcium items[c]	0.9±0.7	1.0±0.8	.169
4 Posttest calcium items	1.0±0.8	1.4±0.9	<.001
6 Pretest folate items	1.6±1.1	1.7±1.1	.581
6 Posttest folate items	1.8±1.2	2.3±1.4	<.001

[a] Traditional curriculum (TC), n=210; IMM enhanced curriculum (IMM), n=208
[b] Independent t-test values
[c] Cognitive test items pertaining to calcium or folate

Table 25 Mean cognitive total pretest and posttests scores of students enrolled in introductory nutrition classes by location

Location/Group		n	Pretest[a]	Posttest	p[b]
			Mean ± standard deviation		
AR	TC[c]	54	6.0±1.7	6.2±2.4	.517
DE	TC	52	6.8±2.6	7.1±2.5	.434
FL	TC	18	5.9±2.1	7.0±2.0	.144
TX	TC	86	6.7±2.3	9.4±2.7	<.001
AR	IMM	48	6.3±2.2	6.8±2.2	.199
CA	IMM	14	8.1±2.5	9.8±3.2	.020
DE	IMM	22	7.5±2.9	10.6±3.5	.002
FL	IMM	24	5.5±2.0	8.1±3.8	.001
IN	IMM	35	8.3±2.7	13.2±3.7	<.001
OK	IMM	28	5.8±1.8	8.8±3.0	<.001
TX	IMM	37	7.7±2.3	9.7±2.6	<.001
Totals	TC	210	6.5±2.2	7.8±2.8	<.001
	IMM	208	7.0±2.6	9.4±3.7	<.001

[a] 21-item cognitive test
[b] Paired t-test values
[c] Traditional curriculum (TC), IMM enhanced curriculum (IMM)

Table 26 Mean cognitive total and subset scores for students enrolled in advanced nutrition classes

Test items	Knowledge scores TC[a]	IMM	p[b]
	Mean ± standard deviation		
33 Pretest cognitive items total[c]	12.7±4.0	12.7±3.0	.973
33 Posttest cognitive items total	13.8±3.6	17.1±4.1	<.001
14 Pretest knowledge items	6.5±2.3	6.3±1.8	.683
14 Posttest knowledge items	7.1±2.2	8.5±2.5	<.001
9 Pretest application items	3.6±1.5	3.6±1.6	.940
9 Posttest application items	4.0±1.7	4.8±1.4	<.001
10 Pretest analysis items[d]	2.6±1.6	2.8±1.3	.529
10 Posttest analysis items	2.7±1.3	3.6±1.4	<.001
6 Pretest calcium items[e]	1.5±1.0	1.4±0.9	.491
6 Posttest calcium items	1.7±1.1	2.0±1.2	.051
6 Pretest folate items	2.8±1.3	2.5±1.1	.258
6 Posttest folate items	2.8±1.2	3.5±1.4	.001

[a] Traditional curriculum (TC), n=60; IMM enhanced curriculum (IMM), n=122
[b] Independent t-test values
[c] 33 items: 14 knowledge, 9 application, and 10 analysis
[d] 10 analysis of diet histories and selection of meals by nutrient content items
[f] Items pertaining to calcium or folate

Table 27 Mean cognitive total scores and change in cognitive scores for students enrolled in advanced nutrition classes by location

Location	Group	n	Pretest[a]	Posttest	p[b]
			Mean ± standard deviation		
IA	TC[c]	17	13.5±4.2	14.6±4.0	.100
IN	TC	24	13.2±3.4	13.9±3.8	.141
TX	TC	19	11.5±4.5	13.1±3.1	.122
DE	IMM	24	12.1±2.2	14.8±3.2	<.001
FL	IMM	20	13.5±2.1	15.2±3.2	.031
IA	IMM	25	13.4±3.0	18.7±3.3	<.001
IN	IMM	18	13.9±3.5	15.7±4.1	.012
OK	IMM	24	11.5±3.4	18.8±4.5	<.001
TX	IMM	11	11.7±3.5	19.8±4.1	<.001
Totals	TC	60	12.7±4.0	13.8±3.6	.008
	IMM	122	12.7±3.0	17.1±4.1	<.001

[a] 33 items: 14 knowledge, 9 application, and 10 analysis
[b] Paired t-test values
[c] Traditional curriculum (TC); IMM enhanced curriculum (IMM)

Table 28 Mean cognitive total and subset scores for students enrolled in introductory and advanced nutrition classes

Test items	**Introductory**	**Advanced**	**p**[a]
	Mean ± standard deviation		
Traditional curriculum	(n=210)	(n=60)	
21 Pretest cognitive items[b]	6.5±2.2	9.9±3.3	<.001
21 Posttest cognitive items	7.8±2.8	10.8±3.2	<.001
14 Pretest knowledge items	4.5±1.7	6.5±2.3	<.001
14 Posttest knowledge items	5.2±2.1	7.1±2.2	<.001
7 Pretest application items	2.0±1.2	3.4±1.5	<.001
7 Posttest application items	2.6±1.3	3.7±1.5	<.001
4 Pretest calcium items[c]	0.9±0.7	1.2±0.8	.003
4 Posttest calcium items	1.0±0.8	1.4±1.0	.004
6 Pretest folate items	1.6±1.1	2.8±1.3	<.001
6 Posttest folate items	1.8±1.2	2.8±1.2	<.001
IMM enhanced curriculum	(n=208)	(n-122)	
21 Pretest cognitive items	7.0±2.6	9.7±2.6	<.001
21 Posttest cognitive items	9.4±3.7	12.9±3.2	<.001
14 Pretest knowledge items	4.8±1.8	6.3±1.8	<.001
14 Posttest knowledge items	6.2±2.6	8.5±2.5	<.001
7 Pretest application items	2.2±1.4	3.4±1.4	<.001
7 Posttest application items	3.2±1.6	4.4±1.3	<.001
4 Pretest calcium items	1.0±0.8	1.1±0.7	.165
4 Posttest calcium items	1.4±0.9	1.6±1.0	.025
6 Pretest folate items	1.7±1.1	2.5±1.1	<.001
6 Posttest folate items	2.3±1.4	3.5±1.4	<.001

[a] Independent t-test values
[b] 21 item cognitive test: 14 knowledge and 7 application questions
[c] Items pertaining to calcium or folate

Table 29 Mean attitude total and subset scores for students enrolled in advanced nutrition classes

Test items	**Knowledge scores**		
	TC[a]	**IMM**	**p**[b]
	Mean ± standard deviation		
Introductory	(n=122)	(n=208)	
15 Pre-intervention attitude items	52.7±4.5	53.5±4.1	.709
15 Post-intervention attitude items	54.5±4.8	56.6±4.8	.001
3 Pretest calcium items[c]	11.6±1.9	12.0±1.6	.018
3 Posttest calcium items	11.6±1.9	12.0±1.7	.02**9**
3 Pretest folate items	10.2±1.3	10.3±1.3	.258
3 Posttest folate items	10.6±1.4	10.7±1.3	.717
Advanced	(n=60)	(n=122)	
15 Pre-intervention attitude items	55.8±4.9	55.8±4.3	.925
15 Post-intervention attitude items	57.3±4.3	58.4±4.4	.294
3 Pretest calcium items	12.3±1.9	12.0±2.0	.337
3 Posttest calcium items	12.3±1.8	12.0±2.0	.445
3 Pretest folate items	11.3±1.2	11.2±1.3	.593
3 Posttest folate items	11.1±1.3	11.0±1.4	.665

[a] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[b] Independent t-test values
[c] Items pertaining to calcium or folate

Table 30 Total attitude scores of students enrolled in introductory and advanced nutrition classes by location

Location	Group	n	Pretest[a]	Posttest	p[b]
Introductory			Mean ± standard deviation		
AR	TC[c]	54	53.6±4.5	54.1±5.5	.460
DE	TC	52	53.9±4.5	53.9±4.1	.975
FL	TC	18	52.2±3.5	53.2±3.1	.171
TX	TC	86	52.7±4.5	56.1±4.7	<.001
AR	IMM	48	53.3±3.8	55.2±5.0	.009
CA	IMM	14	54.4±4.1	57.1±4.4	.096
DE	IMM	22	52.6±3.6	55.2±3.0	.004
FL	IMM	24	52.9±3.9	56.0±3.6	.001
IN	IMM	35	56.0±3.3	57.5±4.4	.075
OK	IMM	28	52.5±7.2	56.5±4.1	.009
TX	IMM	37	55.2±4.3	56.6±4.9	.076
Total	TC	210	53.2±4.5	54.8±4.7	<.001
Total	IMM	208	53.8±4.6	56.2±4.4	<.001
Advanced					
IA	TC	17	57.7±5.4	58.1±6.3	.675
IN	TC	24	57.5±3.3	56.5±3.5	.129
TX	TC	19	54.1±4.2	56.8±5.0	.030
DE	IMM	24	57.8±5.4	58.1±4.5	.874
FL	IMM	20	53.8±5.1	56.4±5.0	.009
IA	IMM	25	57.9±3.2	58.7±2.8	.212
IN	IMM	18	56.5±5.0	58.1±4.7	.134
OK	IMM	24	55.8±3.3	56.7±3.2	.189
TX	IMM	11	55.3±5.4	60.1±4.7	.075
Total	TC	60	56.5±4.5	57.1±4.9	.278
Total	IMM	122	56.8±4.2	57.8±4.2	.001

[a] 15 attitude questions
[b] Paired t-test values
[c] Traditional curriculum (TC); IMM enhanced curriculum (IMM)

Table 31 Mean self-efficacy total scores and subset scores for students enrolled in introductory and advanced nutrition classes

	Self-efficacy scores **TC**[a]	**IMM**	**p**[b]
	Mean ± standard deviation		
Introductory	(n=210)	(n=208)	
8 Pretest self-efficacy total items[c]	23.2±5.5	23.0±5.3	.685
8 Posttest self-efficacy total items	27.6±4.7	31.5±4.7	<.001
2 Pretest calcium self-efficacy items[d]	6.7±1.7	6.9±1.6	.341
2 Posttest calcium self-efficacy items	7.5±1.5	8.2±1.3	<.001
2 Pretest folate self-efficacy items	5.0±1.7	4.8±1.6	.071
2 Posttest folate self-efficacy items	6.0±1.7	7.4±1.7	<.001
Advanced	(n=60)	(n=122)	
12 Pretest self-efficacy total items	43.2±7.5	44.8±6.7	.151
12 Posttest self-efficacy total items	43.4±6.2	47.9±5.9	<.001
3 Pretest calcium self-efficacy items[d]	12.3±2.0	12.3±1.8	.968
3 Posttest calcium self-efficacy items	12.0±1.7	12.6±1.6	.018
3 Pretest folate self-efficacy items	9.9±2.6	10.2±2.3	.500
3 Posttest folate self-efficacy items	10.1±2.0	11.3±1.9	<.001

[a] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[b] Independent t-test values
[c] Items pertaining to calcium or folate self-efficacy items

Table 32 Mean total self-efficacy scores of students enrolled in introductory and advanced nutrition classes by location

Location	Group	n	Pretest	Posttest	p[a]
Introductory			Mean ± standard deviation		
AR	TC[b]	54	22.9±4.9	26.7±4.8	<.001
DE	TC	52	24.7±5.0	25.9±4.1	.046
FL	TC	18	24.3±6.2	27.7±4.6	.045
TX	TC	86	22.3±5.9	29.1±4.6	<.001
AR	IMM	48	22.1±5.1	29.2±4.6	<.001
CA	IMM	14	24.5±6.2	31.1±3.0	.006
DE	IMM	22	22.8±5.3	32.4±4.9	<.001
FL	IMM	24	22.6±4.3	31.1±3.3	<.001
IN	IMM	35	25.3±4.5	35.3±4.4	<.001
OK	IMM	28	20.5±6.0	30.8±4.4	<.001
TX	IMM	37	23.7±4.9	31.2±4.8	<.001
Total	TC	210	23.2±5.5	27.6±4.7	<.001
Total	IMM	208	23.0±5.3	31.5±4.7	<.001
Advanced					
IA	TC	17	44.4±7.4	42.6±6.2	.243
IN	TC	24	44.8±5.8	42.8±5.3	.098
TX	TC	19	40.1±8.8	44.7±7.3	.017
DE	IMM	24	47.0±6.9	47.4±6.6	.732
FL	IMM	20	47.2±6.9	49.2±6.2	.274
IA	IMM	25	45.5±4.2	46.0±5.7	.659
IN	IMM	18	44.6±7.0	47.6±5.4	.046
OK	IMM	24	42.4±7.0	48.2±4.5	<.001
TX	IMM	11	39.3±4.7	50.8±6.8	<.001
Total	TC	60	43.2±7.5	43.4±6.2	.870
Total	IMM	122	44.8±6.7	47.9±5.9	<.001

[a] Paired t-test values for significance in pretest and posttest scores by site
[b] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[c] 8 introductory items with a maximum score of 40; 12 advanced items with a maximum score of 60

Table 33 Mean intake of energy, calcium, and folate for males and females enrolled in introductory nutrition classes

Nutrient	**Females** (n=164) Mean intake[a]	Range	**Males** (n=46) Mean intake[a]	Range
Energy (kcal)	1837±660	494-5447	2679±859	1185-5242
Calcium (mg)	877±493	50-3047	1180±795	67-4387
Calcium per 1000 kcal[b]	490±247	59-1626	434±227	57-1079
Calcium % DRI[c]	88±49	5-305	118±79	7-439
Folate (µg)	382±207	44-1456	512±261	28-1303
Folate per 1000 kcal	217±119	45-1285	198±106	24-743
Folate % DRI	96±52	11-364	128±65	7-326

[a] Mean ± standard deviation of combined pre- and post-intervention 1-day food record data
[b] Kilocalorie=kcal
[c] Dietary Reference Intake (DRI): 1000 mg calcium, 400 µg folate

Table 34 Mean calcium and folate intakes for students enrolled in introductory nutrition classes

Nutrient	**TC[a]**	**IMM**	**p[b]**
	Mean ± standard deviation		
Male and female intake	(n=117)	(n=128)	
Pre-[c] calcium	990±622	906±586	.277
Post- calcium	924±472	963±564	.564
Pre- calcium per 1000 kcal[d]	472±239	486±251	.676
Post- calcium per 1000 kcal	444±194	537±257	.001
Pre- calcium percent of DRI[e]	99±62	91±59	.277
Post- calcium percent of DRI	92±47	96±56	.564
Pre- folate	399±234	384±186	.585
Post- folate	430±237	436±231	.858
Pre- folate per 1000 kcal	194±95	208±89	.221
Post- folate per 1000 kcal	206±104	255±150	.003
Pre- folate percent of DRI	99±58	96±47	.585
Post- folate percent of DRI	108±59	109±58	.858

[a] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[b] Independent t-test
[c] Pre-intervention = Pre-; Post-intervention = Post-
[d] Kilocalorie=kcal
[e] Daily reference intake: 1000 mg calcium, 400 μg folate

Table 35 Mean intakes of calcium and folate per 1000 kilocalories for students enrolled in introductory nutrition classes by location

Location	Group	n	Pre-intervention	Post-intervention	p[a]
Calcium (mg)			Mean ± standard deviation		
AR	TC[b]	36	432±233	457±187	.510
DE	TC	23	526±317	508±220	.785
FL	TC	10	432±176	339±137	.075
TX	TC	48	486±212	425±188	.094
AR	IMM	36	443±193	412±206	.495
DE	IMM	17	660±302	700±395	.675
FL	IMM	9	350±128	504±264	.119
IN	IMM	32	529±223	595±178	.049
OK	IMM	12	316±176	526±227	.016
TX	IMM	22	530±317	559±231	.603
Totals	TC	117	472±239	443±194	.212
Totals	IMM	128	486±251	537±257	.039
Folate (μg)					
AR	TC	36	194±92	182±70	.421
DE	TC	23	182±108	246±153	.047
FL	TC	10	220±141	156±68	.231
TX	TC	48	193±81	215±98	.137
AR	IMM	36	187±73	218±102	.167
DE	IMM	17	257±108	381±292	.121
FL	IMM	9	189±59	366±102	.048
IN	IMM	32	213±88	261±107	.011
OK	IMM	12	162±94	200±127	.232
TX	IMM	22	232±87	226±77	.824
Totals	TC	117	194±95	206±104	.259
Totals	IMM	128	208±89	254±150	.001

[a] Paired t-test for sites, independent t-test for totals
[b] Traditional curriculum (TC), IMM enhanced curriculum (IMM)

Appendix I

Table for Chapter 5: Discussion

Table 36 Mean cognitive total and subset percent correct scores for students enrolled in introductory and advanced nutrition classes

Test items	**Percent correct**		
	TC[a]	**IMM**	**p[b]**
	Mean ± standard deviation		
Introductory	(n=210)	(n=208)	
21 Pretest cognitive items	31±11[c]	33±12	.024
14 Pretest knowledge items	32±13	34±13	.111
7 Pretest application items	29±17	31±20	.053
4 Pretest calcium items[d]	23±18	25±20	.764
6 Pretest folate items	27±18	28±18	.560
21 Posttest cognitive items	37±13	45±18	<.001
14 Posttest knowledge items	37±15	44±19	<.001
7 Posttest application items	37±19	46±23	<.001
4 Posttest calcium items	25±20	35±23	<.001
6 Posttest folate items	30±20	38±23	.001
Advanced	(n=60)	(n=122)	
33 Pretest cognitive items total	38±12	38±9	.973
14 Pretest knowledge items	46±16	45±13	.683
9 Pretest application items	40±17	40±18	.940
10 Pretest analysis items	26±16	28±13	.529
6 Pretest calcium items[d]	25±17	23±15	.491
6 Pretest folate items	47±22	42±18	.258
33 Posttest cognitive items total	42±11	52±12	<.001
14 Posttest knowledge items	51±16	61±18	<.001
9 Posttest application items	44±19	53±16	<.001
10 Posttest analysis items	27±13	36±14	<.001
6 Posttest calcium items	28±18	33±20	.051
6 Posttest folate items	47±20	58±23	.001

[a] Traditional curriculum (TC); IMM enhanced curriculum (IMM)
[b] Independent t-test values
[c] Mean ± standard deviation
[d] Cognitive test items pertaining to calcium or folate

Glossary

The following abbreviations were used in the text of this document.

USDA	United States Department of Agriculture
USKHHS	United States Department of Health and Human Services
DRI	Daily Reference Intake
RDA	Recommended Dietary Allowances
AI	Adequate Intake
NHANESIII	National Health and Nutrition Examination Survey
CSFII/DHKS	Continuing Survey of Food Intakes by Individuals and Diet and Health Knowledge Survey
NHIS	National Health Interview Surveys
IMM	Interactive Multimedia
TC	Traditional curriculum
CAI	Computer-assisted Instruction

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