Adapting the contents of computer-based instruction based on knowledge tests maintains effectiveness of nutrition education[1–4]

Martin Kohlmeier, Walter J McConathy, Karen Cooksey Lindell, and Steven H Zeisel

ABSTRACT

Background: Nutrition education of many medical students continues to be inadequate. Computer-based instruction in nutrition is a resource that introduces a new level of flexibility for instructors and students while maintaining a high level of educational quality. Previous evaluations have demonstrated the efficacy of our programs on nutrient physiology and the role of nutrition in the disease process, but some students complained about the time spent on content that they had covered in other courses.

Objective: We wanted to explore the effectiveness of an abbreviated program version that bypassed topics that the students had mastered already.

Design: Multiple-choice questions were used to determine knowledge of 117 second-year medical students in each of the main knowledge areas covered by our Nutrition and Cancer instructional module. The students were then randomly assigned to complete either the full version or a shortened version adapted to their demonstrated knowledge. Four days later the same as well as new questions were used to compare knowledge gain between the 2 groups.

Results: The shorter time spent with the tailored version than with the full version (2.5 h versus <1.5 h) decreased learning efficacy to only a small extent. More tailored-version users than full-version users were interested in further computer-based instruction (59% versus 41%, $P < 0.05$), suggesting better acceptance.

Conclusions: Our experience underscores the power of computer-based instruction to bring nutrition education to medical students. The newly developed adaptive features of the nutrition programs may also be helpful for practicing physicians to efficiently bridge knowledge gaps.   *Am J Clin Nutr* 2003;77(suppl):1025S–7S.

KEY WORDS   Computer-based instruction, nutrition education, cancer education, efficacy evaluation, tailored instruction

INTRODUCTION

The Nutrition in Medicine series was developed to support nutrition education in the many medical schools that did not have a nutrition course and to augment the efforts of schools with a curriculum already in place (1). Nine separate modules present the physiologic and biochemical basis of nutrient metabolism and illustrate the application of this knowledge in clinical practice (2). The goal of the series is to make medical students aware of the health impact of their patients' dietary habits and nutritional status, and teach them basic skills for assessment of and decision making regarding dietary treatment options (3). So far, 9 modules have been developed; together, they provide a full curriculum in human nutrition. The scope of the covered topics is based on the consensus statement by the American Society for Clinical Nutrition (4) and regularly reviewed and updated by our advisory board of nationally respected experts in nutrition education. Each of the 2–3-h-long modules uses videotaped case presentations to capture the interest of the students and showcase the role of health professionals in nutritional assessment and therapy. Lesson components teach the scientific basis for established nutritional practices and provide relevant information on clinical implementation.

Overall, these modules have been well received by students and instructors. The only consistent complaint by students concerns the length of the programs. They usually compared a 1-h lecture with the 2 to 3 h it took to complete a module. The modules are self-contained and provide background information beyond the scope of the nutritional issues under discussion. This ensures that students at different stages of their education and with different levels of competencies understand principles of nutrient metabolism as well as dietary assessment and intervention. Many students are already familiar with the basic concepts and are ready to embark directly on the nutrition issues. In a recent survey (1999–2000), 25 out of 98 responding medical schools reported that they integrated some component of their nutrition education offerings into other courses (5). Second-year students will have already learned some principles of nutritional physiology and biochemistry in the course of their studies. It would thus be desirable to adapt the instruction to the needs of the class and potentially gain time for additional relevant topics.

To explore the possibility of adapting the program to the needs of specific groups of students, we undertook a proof-of-concept study with a class of second-year medical students using the Nutrition and Cancer module.

METHODS

Participants and design

All 117 second-year students of the program at the North Texas University Health Sciences Center at Fort Worth participated in this evaluation. The students were randomly assigned to either group A ($n = 58$) or group B ($n = 59$). Familiarity of all students with key components of the computer module was assessed with the pretest described below. Group A had to complete all lessons and case studies. Group B had to complete a module component only if fewer than 60% of the class knew the correct answer to the associated test item. Both groups were required to complete the interactive video case studies, however. The students had 4 d to complete their assignments before taking another written test.

The study design was reviewed and approved by the Institutional Review Board of the North Texas University Health Sciences Center at Fort Worth.

Test items

Twelve multiple-choice test items were used for an initial assessment of participants' familiarity with key concepts of the module. The items had been used and validated in previous studies (6). Additional subjective questions were included for the assessment of attitudes and self-efficacy. The posttest contained the same 12 knowledge questions, but with answers presented in a different order. All questions on the pretest, except one, had an additional matched item, which covered the same content area and had a similar level of difficulty. Attitudinal questions were included again and the students were also asked about the amount of time they spent using the program.

Statistical analysis

Group differences were tested with the Kolmogorov-Smirnov 2-sample test for continuous variables and with chi-square statistics for categorical variables. All calculations were carried out with the Statgraphics Plus version 5 (Manugistics, Inc, Rockville, MD).

RESULTS

All 117 students took the initial assessment test (pretest) on day 1, studied the assigned modules, and completed the achievement test (posttest) 4 d later.

The pretest indicated that the students knew about general principles of carcinogenesis, malignant transformation, tumor suppressor genes, apoptosis, oncogenes, immune surveillance, hypothesis formulation, and study designs. On the other hand, they were not familiar with mechanisms and the role of nutrition in DNA adduct formation, activation and elimination of carcinogens, oxygen free radical generation and antioxidant defense, hormone and phytoestrogen functions, interpretation of population studies, cancer prevention strategies, and tumor cachexia and adjunct nutrition support for cancer patients.

Based on these findings, students in group B were given written instructions that directed them to study only the latter 7 areas. The abbreviated version corresponded to about 57% of the full module content.

The median of the time that group A spent with the Nutrition and Cancer module was 2.5 h (self-reported); group B took <1.5 h. Because of the broad spacing of offered choices for the time question, the time estimate cannot be given more accurately for group B.

The 2 groups did not show a statistically significant difference in the percentage of correct answers to the 12 pretest questions (47.7% for group A, 49.4% for group B) or posttest (62.3% vs 60.1%). The 11 questions that were used for only the posttest were in a similar range, but with a slightly higher percentage of correct answers for users of the full version. The students who were to complete the entire module (group A) got 67.2% correct answers on the 11 questions that were used for only the posttest; the students with the abbreviated version (group B) got 61.0% right. Again, the difference was not statistically significant.

The pattern was the same when considering only the 7 questions relating to those topics that both groups had to cover. Group A had a somewhat higher percentage of correct answers than group B, both with the previously seen questions (71.0 vs 52.6%, $P < 0.05$) and with the new questions (68.0 vs 62.9%, $P < 0.05$).

In the topic areas that group B was instructed to bypass, there was no statistically significant difference in knowledge. Group A got more answers to 2 not previously seen questions right than group B, but the differences were not statistically significant. One question covering epidemiologic methods and designs required an understanding of case-control studies (66% vs 45%). The other question dealt with carcinogens in foods (67% vs 53%). Two of the other questions on omitted topics gave slightly lower results, and 2 others slightly higher results for group B. The difference was <7% in each case.

Interestingly, when attitudes were assessed, more students of group B than of group A agreed that they would like to see more computer modules incorporated into their curriculum (59% vs 41%, $P < 0.05$). Initially, 46% of both groups had agreed with this statement.

DISCUSSION

Previous evaluations have shown that medical students can learn well with the Nutrition and Cancer module in diverse course formats, including self-instruction, small group studies, and integrated components of case-study seminars (6–9). The 2–3 h needed to complete the entire module has been a persistent problem, however, because some instructors and students expect this topic to be covered by a 1-h lecture. Unlike with a book, a learner cannot easily discern whether a section or page is likely to contain needed information. Although users can navigate freely to any section of the program, this does not happen much in practice. This medium also lacks the option (available with print materials) to review synoptically adjacent pages or quickly browse through familiar material to improve retention. Our computer-based instruction format is closer in nature to a lecture or seminar in this respect. Instructors can define with a previously developed option to which program component the students will navigate, but they are often unsure about the best selection.

Tailoring instruction based on preexisting knowledge level is an effective way to guide users to components that deserve more study (10, 11). A large portion of the Nutrition and Cancer module was found to cover topics that this group of second-year medical students already knew about. The students who were instructed to omit them took only about half as long without losing much in learning efficacy.

The main difficulties with this approach relate to the time needed for preparing and validating appropriate test questions and to the time spent by the students for test taking before they begin to study. Both pose formidable barriers. Developing useful

test instruments still takes months and is costly. The users of the short version saved about 1 h, but it took them about 30 min to complete the pretest. This represents a net gain of time for this group and with this module, but the right balance has to be found in each case. An added benefit was better acceptance of the shortened version. Thus, complaints about excessive length can be addressed in a constructive and satisfying way.

Tailoring instruction to their knowledge level may also work well for past graduates such as practicing physicians. They are certainly familiar with most presented concepts. The initial assessment will help them to spend time on only topics that have evolved more recently or that they did not have an opportunity to cover previously. Shorter use time may in many cases make the difference that allows a busy practitioner to update his or her nutrition knowledge.

Given that we are developing Web-supported use of the nutrition modules, both difficulties might soon be reduced to a more manageable level. Once the Web support is available, it will be possible to add individual test items to the regular module material of a few users at a time. This will allow the rapid evaluation of test items without burdening users unduly, because each will only rarely encounter an extra one. Once a sufficient number of good test items is available, users can be assessed on an as-needed and just-in-time basis. One or a few questions will be sufficient to determine whether they need to review a particular topic area. This is likely to be less burdensome than a lengthy assessment at the outset. Such an approach will also allow second-look questions to make sure that a topic is really familiar.

Future evaluations will have to determine the range of knowledge levels of learners. Such information can minimize repetitious instruction and, most important, allow more time to fill knowledge gaps. The hope is that more efficient nutrition instruction will allow medical students to acquire the much-needed knowledge and skills despite a steadily expanding course load in other subjects.

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