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A SELF-INSTRUCTIONAL, MULTI-MEDIA APPROACH
TO FACILITATE THE TEACHING OF THE
INDEX OF NUTRITIONAL QUALITY

by

Claudia Kay Probart

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Nutrition and Food Sciences

UTAH STATE UNIVERSITY
Logan, Utah

1977

TABLE OF CONTENTS

| | Page |
|---|------|
| LIST OF TABLES | iv |
| ABSTRACT | v |
| Chapter | |
| I. STATEMENT OF THESIS PROBLEM | 1 |
| Introduction | 1 |
| Nature and Origin of the Study | 1 |
| Purpose of the Study | 2 |
| Hypothesis | 2 |
| Research Design | 2 |
| Delimitations | 2 |
| Definition of Terms | 3 |
| II. REVIEW OF RELATED LITERATURE | 5 |
| Areas Covered by Review | 5 |
| Nutritional Status of Children | 5 |
| Who Should Teach Nutrition? | 7 |
| When Should Nutrition Education Begin? | 7 |
| How Successful Are Present Nutrition Programs? | 8 |
| Developments in Nutrition Education | 11 |
| Introduction to the Index of Nutritional Quality | 13 |
| III. METHODOLOGY | 17 |
| Purpose | 17 |
| Objectives | 17 |
| Design Approach | 18 |
| Production of the Module | 21 |
| Pilot Tests and Revisions | 25 |
| Description of Instrumentation | 26 |
| Limitations | 28 |

TABLE OF CONTENTS (Continued)

| Chapter | Page |
|---|------|
| IV. RESULTS | 29 |
| Restatement of Purpose | 29 |
| Statistical Analysis | 29 |
| V. DISCUSSION | 35 |
| Statement in Support of Hypothesis | 35 |
| Discussion of Results | 35 |
| Statement of Contribution | 38 |
| Summary | 38 |
| Recommendations | 40 |
| LITERATURE CITED | 41 |
| APPENDIXES | 44 |
| Appendix A. Goals of Teaching Module | 45 |
| Appendix B. Pre-Test Questions | 46 |
| Appendix C. Attitude Survey and Responses | 47 |
| Appendix D. Post-Test Questions | 48 |

LIST OF TABLES

| Table | Page |
|--|------|
| 1. Statistical results of attitude survey | 30 |
| 2. Number and percent of negative responses in pre-test | 31 |
| 3. Results of concepts tested in post-test . . . | 33 |
| 4. Results of concepts tested in post-test. Subjects had no prior exposure to the teaching module | 34 |
| 5. Analysis of variance between correct responses of subjects either having, or having no, exposure to teaching module | 35 |

ABSTRACT

A Self-Instructional, Multi-Media Approach
To Facilitate the Teaching of the
Index of Nutritional Quality

by

Claudia Kay Probart, Master of Science

Utah State University, 1977

Major Professor: Bonita Wyse, Ph.D., R.D.
Department: Nutrition and Food Sciences

A review of the literature dealing with nutrition education established the following: (a) that there is a need for nutrition education at the elementary school level; (b) that elementary teachers do not always have the background or motivation to meet this need for nutrition education; and (c) that new educational methods that are easier to understand and more highly motivating are needed.

The Index of Nutritional Quality (INQ), a nutrient density concept, was developed at Utah State University to answer the need for easily understood and motivating nutrition information. The INQ method of nutrition education has been used and considered successful in actual classroom situations.

Up to this time, the INQ method of teaching was introduced to interested individuals and groups by the various members of the INQ research group--a method that is expensive in time and travel expense and lacks consistency. A less expensive, more standardized

means of disseminating information about the Index of Nutritional Quality was needed.

After consideration of the various types of media available, it was decided that a self-instructional, multi-media unit, including a slide-tape and an accompanying workbook, would be a satisfactory teaching module. The module was developed and tested as a part of this study, using both an attitude survey and a didactic pre-and post-test as evaluation instruments. The test statistics were significant to conclude that learning had taken place as a result of exposure to the unit; and that the module was successful as a teaching devise.

(49 pages)

CHAPTER I
STATEMENT OF THESIS PROBLEM

Introduction

New teaching methods are needed in the field of nutrition education at the elementary school level. As most elementary teachers do not have strong nutrition backgrounds, these new methods should be easy to understand and use in the classroom. As student learning is proportional to the teacher's attitude about nutrition, these new methods should also be motivating to the elementary school teachers.

Nature and Origin of the Study

A nutrition education method has been developed at Utah State University, called the Index of Nutritional Quality (INQ), utilizing a nutrient density concept. The INQ concept compares each of the various nutrients contained in a food item with the kilocalories in that food; expressed as a ratio, Nutrient:Energy. Because this ratio can be expressed graphically, giving a visual representation of the nutrient content in a food, the INQ method met the above criteria of being both easy to understand and motivating to the teachers.

The Index of Nutritional Quality is a new concept that has been tested successfully with elementary school children; however, training the teachers in the use of the method needed to be standardized and simplified.

Purpose of the Study

It was the purpose of this study to design and evaluate an efficient method of instructing elementary school teachers in the theory and use of the Index of Nutritional Quality.

Hypothesis

The use of a self-instructional, multi-media unit would facilitate learning of the INQ method of nutrition education by elementary school teachers.

Research Design

Evaluation of the teaching module was done in two stages. The first procedure consisted of an attitude survey conducted by an outside evaluator. The second procedure consisted of a didactic pre- and post-test. A Student's T test and an analysis of variance were used to test statistical significance.

Delimitations

This study was designed to measure the effectiveness of a multi-media approach to teaching the Index of Nutritional Quality to elementary school teachers. There was no attempt to measure the INQ method specifically, as opposed to other forms of nutrition education; this is being done elsewhere. No conclusions were drawn regarding multi-media instruction in general, but only as it pertained to this study.

Definition of Terms

Used throughout this study were several terms which are unique to the field of nutrition. These are defined in the following paragraphs.

Nutrients: Vital substances that furnish nourishment, without which we would die. These substances include vitamins, minerals, proteins, fats, carbohydrates, and water. Eight nutrients, along with energy, are used in this presentation.

Kilocalories (Kcals): The unit of measure used to express the energy value in foods and the energy needs of people. Sometimes they are spoken of simply as calories, but they are more correctly called kilocalories.

Dietary Standard: These standards indicate amounts of nutrients that should be consumed daily in an individual's diet. The standards used in this study are the Recommended Dietary Allowances.

Recommended Dietary Allowances (RDAs): Established by the National Research Council of the National Academy of Sciences for various population groups. The standards used in this study are for children ages 7 to 10 years old.

Index of Nutritional Quality (INQ): The concept upon which this study is based is termed the Index of Nutritional Quality, abbreviated INQ. An INQ value is specifically calculated for each nutrient of concern in each food item. Using a nutrient density concept, this INQ value allows a precise comparison of each nutrient rating to the food's kilocalories.

Nutrient to Energy Ratio (Nutrient:Energy): A ratio expressing nutrient density. This ratio is the basis of the INQ method, and describes the portion of a nutrient requirement that is met when energy needs are satisfied.

Percent of Standard (%Std): This is the amount (expressed as a percentage) of the established standard (RDA) for a specific nutrient provided by a portion of food. It is found by dividing the amount of that nutrient in the portion of food by the RDA for the nutrient, and multiplying by 100 to express as a percentage.

CHAPTER II
REVIEW OF RELATED LITERATURE

Areas Covered by Review

It is the purpose of this review to establish that there is a need for nutrition education in the United States today. When this need has been established, an attempt will be made to answer the following questions that have been asked regarding nutrition education: Who is in the best position to teach nutrition? When should nutrition education programs be initiated? How successful have nutrition education programs been in the past? A summary of several creative nutrition education programs will follow, including an introduction to the Index of Nutritional Quality, on which this study is based.

Nutritional Status of Children

Many studies have been done which indicate that nutritional status of children in the United States could be improved. Sipple (1971), quoted a United States Department of Agriculture's survey of food intake which showed a drop in the quality of diets consumed by households from 1955 to 1965. This study pointed to a larger percentage of families failing to meet the Recommended Dietary Allowances in 1965 than in 1955.

The Ten-State Nutrition Survey determined that up to 15 percent of selected groups in the United States population failed to

obtain adequate amounts of one or more nutrients. This study showed that children under the age of seventeen had the highest prevalence of nutritional problems. Children as a group are particularly vulnerable to nutritional problems because of their increased need for many nutrients to provide for growth and energy.

Whitehead (1960), as a result of her study involving sixth and seventh grade students in Kansas City, Missouri, came to the conclusion that consumption of milk, eggs, butter or margarine, potatoes and green leafy vegetables was less than the Type A recommendations for both grades studied. Kerrey, et al. (1968), studied the nutritional status of preschool children and found that the nutrients that most often failed to meet the recommended allowances were iron, calcium, and ascorbic acid. In a study of dietary intake of children from the Phoenix, Arizona area involving fourth, fifth and sixth-grade children, Patterson (1971), determined that more than half of the children had diets which failed to meet two-thirds of the 1968 Recommended Dietary Allowances for one or more nutrients. The nutrients most often below two-thirds of the allowances were iron, vitamin A, calcium, thiamin, and ascorbic acid. Patterson concluded, and most authorities agree, that improved practices in food selection are needed. The latest study, released in 1977 by Frank, et al. indicated that these conditions have not improved to date. Frank's study of rural children from ten to sixteen years old found iron, calcium and vitamin A levels below the recommended amounts in most of the children surveyed.

These reports demonstrate the need for nutrition education. Improvement in food consumption patterns would correct these dietary inadequacies. The problem really becomes, then, the poor eating habits of children. The solution to the problem would appear to be obvious--nutrition education.

Who Should Teach Nutrition?

In a review article, Whitehead (1957), discussed the various programs that have been developed over the years to improve nutritional status. Whitehead believes that schools are the logical place to impart nutrition information; and the teacher, who is with the child each day, is the logical person to handle the teaching of nutrition. The data of Emmons and Hayes (1973), substantiated Whitehead's hypothesis. Their survey found that only one-fourth of the homemakers interviewed could provide a definition of "balanced diet." The researchers concluded that mothers had little knowledge of nutrition and their children had even less. Emmons and Hayes strongly urged the establishment of nutrition education programs in the schools, hoping that this would have a positive impact on the nutritional status of the entire family.

When Should Nutrition Education Begin?

Robinson (1976, p. 129), urged that preventive nutrition education be "introduced as early in life as possible to assure maximum effectiveness and to establish patterns of behavior to

carry over into adult life." She has suggested that nutrition education be established in kindergarten and continue through the twelfth grade.

The importance of early nutrition education is emphasized by others in the field. Petersen and Kies (1972), stated that the early elementary years are an opportune time to establish good nutritional habits. Sadowsky (1973), reaffirmed this concept of early nutrition education by stating that the earlier in the child's life that nutrition education can be implemented, the more positive will be the benefits.

In 1969, the White House Conference of Food, Nutrition and Health recommended that Nutrition education be taught in all schools in the United States, in grades from kindergarten to twelfth. More recently, Robert Barclay (1977) reported that two important nutrition education bills have been introduced in the House and Senate that would provide funds for the establishment of nutrition education activities in schools. This is an indication that those who establish governmental priorities have begun to recognize the importance of early nutrition education.

How Successful Are Present Nutrition Programs?

The real goal in nutrition education is to improve the nutritional status of the population. There are some who have questioned whether this goal has been met with current nutrition programs.

It is evident that most authorities feel that early introduction of nutrition in the schools is desirable. But are teachers prepared

to handle nutrition education? The results of several studies would indicate that elementary teachers do not always have the background necessary to teach nutrition using current methods.

Petersen and Kies (1972, p. 11), state "past nutrition education programs have tended to stress acquisition of nutrition facts rather than promotion of good food habits." This was also the conclusion of the Tennessee Health Education Project's research group (Kirk, Hamrick and McAfee, 1975). In this project, nutrition education was given primary emphasis in the classroom--but the nutritional status of the children involved was not improved. The authors of the report concluded that the poor results were caused by the lack of effectiveness of the traditional approach used in teaching nutrition.

Dwyer (1970) surveyed 1,338 students in urban Massachusetts to determine why they do not find nutrition, as currently taught, to be motivating to change food habits. The majority of students indicated that they felt that nutrition was less interesting than other health education courses. Some of the reasons that they gave to explain this lack of interest were that nutrition classes were "boring" and "old-hat"; that they had to memorize useless information; that they were given facts rather than application; and that the teacher was "uninterested and presented material poorly and in a dull manner."

It was suggested by Head (1974), that there is a positive correlation between the teacher's attitude about nutrition and the success of the nutrition programs in the classrooms. Many teachers have a

poor attitude about nutrition because they have a limited background in the subject. A survey of Nebraska schools (Petersen and Kies, 1972), discovered that only 9 percent of the elementary teachers had had a separate course in nutrition at the college level, and 33 percent had had no exposure to nutrition at the college level. In addition, 83 percent of the teachers stated that they had had no preparatory instruction in methods of teaching nutrition. The authors concluded that not only do the teachers have a minimal background in nutrition knowledge, but also they have relatively no preparation in methods of teaching nutrition in the classroom.

Whitehead (1957) reported the work of Sperry, who noticed as early as 1944 that teachers have a sparse background in nutrition. Sperry stated the need for nutritional materials to help the teacher with nutritional concepts. Kirk (1975) noted that especially materials that could help the teachers to integrate nutrition into existing curricula were needed. Sipple (1971) made the statement that the methods of imparting information must be changed before any improvement in nutrition education can be expected. He noted that there is a definite need to find out how to motivate people to accept and use nutritional information.

From the preceding survey of literature, it is evident that the nutrition of children is not as good as it could be. Most authorities agree that there is a need for nutrition education at the elementary school level, but elementary teachers do not always have the background or motivation to meet this need for nutrition education. Many nutritionists are urging the development of new

educational methods that are easier to understand and more highly motivating. Health orientated organizations and affiliations, such as the American Heart Association, the American Health Foundation, and the Intersociety Commission for Heart Disease Resources are also urging a "comprehensive and sustained nutrition education program for the public and in professional schools and teacher's collages." (As reported by Robinson, 1976, p. 130.)

A more comprehensive nutrition education program in teacher's collages would be an improvement, but would not solve the entire problem. Learning additional facts about nutrition is not intrinsically any more motivating for the teachers than it is for the children. The study by Petersen and Kies (1972) was evidence that an increased knowledge of nutrition will not guarantee that teachers will develop a better attitude toward teaching nutrition in the classroom. Not only is more nutrition needed at the college level, but also better methods of teaching nutrition information to the elementary children must be developed.

Developments in Nutrition Education

Sodowsky (1973) reported of an innovative nutrition education workshop for elementary teachers. The workshop used a combination of learning resources including books, films and a puppet show which illustrated methods and techniques in nutrition education. The evaluation of the workshop, determined by a written questionnaire immediately following the workshop and after a five month period, indicated that many of the ideas and practices learned at the work-

shop were being implemented by the elementary teachers. The five-month follow-up reported that a total of 138 ideas suggested by the workshop were actually being carried out in the classrooms. The researchers reported, in addition, that parents had stated to the project director and to the teachers involved that their children had a positive impact on family consumption patterns.

Sipple (1971) reported on another successful workshop held at the Tuskegee Institute in Alabama. The purpose of the workshop was to increase and improve the nutrition education offered in the curricula in Alabama schools. The participants included classroom teachers, vocational and home economic teachers. Reports of the workshop were highly favorable.

From the above reviews, it is evident that a properly conducted, well planned nutrition education workshop could be successful in training and motivating elementary teachers in the field of nutrition. Figures of the costs of such workshops were not given in the articles reviewed.

The National Dairy Council has made the largest commitment to education among food-related industries. A study was made in 1970 (Levett, Barker and Marcus) to determine the effectiveness of using a Dairy Council program of nutrition, including materials and specified teaching methods. This study was supported by the Dairy Council of California, but was conducted by an independent testing organization. Second-grade teachers and their students were used as subjects. The study evaluated learning achieved by the teachers and the effectiveness of these teachers in their classrooms. The

reported results were very good. The program was credited for improving the learning of the teachers by 69 percent. The researchers reported that the teachers were complimentary toward the training, the materials used, and the instruction given.

The reported results of this study were better than the results usually achieved by the traditional nutrition lessons, indicating that a well planned sequence of lesson plans, coordinated with good visual aids can be successful in teaching nutrition in the elementary school. Although Dairy Council materials are widely available and inexpensive, the availability and expense of the course of instruction was not indicated in this report.

A twenty-hour nutrition minicourse for high school students has been developed at Massachusetts Institute of Technology which can be incorporated into other science units (Picardi and Pariser, 1975). The unit combines animal feeding studies conducted by the students with chemical determinations of different types of eating patterns. Although the evaluation of this work has not been completed, preliminary work appeared to be positive. The minicourse was directed toward high school students; it seems that it would be easily adaptable to elementary students.

Introduction to the Index of Nutritional Quality

There are many programs being developed in the field of nutrition education, the preceding being only a small sample. The concept on which the remainder of this report will concentrate is the Index of Nutritional Quality developed at Utah State University

(Hansen, 1973), (Sorenson and Hansen, 1975), (Wyse, Sorenson, Wittwer and Hansen, 1976), (Sorenson, Wyse, Wittwer and Hansen, 1976). Some of the advantages of the Index of Nutritional Quality are described as follows:

...a readily understood means of nutrient analysis designed to take advantage of data processing techniques and to organize and clarify nutritional information. It can be used for menu and recipe analysis, dietary evaluation, assisting in the regulation of clinical diets, and determining nutritional trends, as well as providing a basis for public nutrition education. (Sorenson, Wyse, Wittwer and Hansen, 1976, p. 236.)

The Index of Nutritional Quality is a nutrient density approach, using a mathematical ratio to relate the amount of a nutrient in a food to the amount of energy in the food. This is felt by many to be an important concept because kilocalories, rather than nutrient requirements, usually determine food consumption. It therefore becomes necessary to try to consume the daily nutrient requirements within the recommended kilocalorie needs.

This index was designed to help people compare nutrients to energy, visually--using a graphic representation of the nutrients contributed by various food items in their diets. It is this visual aspect of the Index of Nutritional Quality that makes it particularly adaptable for nutrition education.

In the preceding sections, the need for better methods of teaching nutrition was established through a review of the literature. The methods must be both motivating and easy to use and understand. It is felt that the Index of Nutritional Quality meets this criteria.

The Index of Nutritional Quality is felt to be motivating to teachers and students for the following reasons:

Unlike traditional nutrition education programs, it does not tell students what they can or cannot eat. Such rules too often impose unacceptable or unreasonable dietary restrictions. Instead, students are encouraged to "mix and match" foods to meet nutrient requirements while satisfying their own individual taste preferences. This approach to dietary selection allows for the use of non-traditional food combinations and encourages the use of ethnic foods. (Utah State University, Dept. of Nutrition and Food Sciences, 1977)

In addition to the approach being more motivating, numerous visual materials, unique to the program have been developed, which make the Index of Nutritional Quality easy to understand and use in the classroom. These materials include Food Profile Cards for 128 different foods. These cards are printed on colorful paper with a picture of the food and the nutrient information that allows the child to "see" the nutrient contribution of each food. An "INQ Nutrition Education Curriculum" has been developed which includes three teaching manuals and two student skillbooks, as well as additional information on how the curriculum can be integrated into the present classroom program. (Brown, 1977)

The INQ method of nutrition education is especially useful in teaching nutritional concepts to young children and to those with limited reading skills. Because the instructional materials (Food Profile Cards) have easily identified foods and color-coded nutrient lines for each food item, reading is not necessary to understand the nutritional concepts.

Guthrie (1977), in a review article, discussed the merits of the Index of Nutritional Quality and concluded the following:

The chances of any selection of foods which meets energy requirements resulting in a diet that meets nutrient standards will be enhanced if more foods are chosen from those that meet the NCBR (INQ) criterion, since each will contribute at least as high a percent of the nutrients under consideration as of calories. (Guthrie, 1977, p. 19.)

Although the Index of Nutritional Quality has been favorably received by many nutritionists and health care professionals and has been proven, in pilot studies, to be a successful nutrition teaching method, the need is evident for the development of a standardized, simple method of disseminating the information to the teaching population. It is the purpose of this study to design, produce and analyze such a teaching unit.

CHAPTER III

METHODOLOGY

Purpose

Recognizing the critical need for nutrition education for both the elementary school student and the elementary school teacher, researchers at Utah State University have devised an approach for communicating nutrition information that is both highly motivating and easy to use and understand, called the Index of Nutritional Quality (INQ), a nutrient density approach.

Although extensive instructional materials have been developed for classroom use and for integration of the INQ method of nutrition education into the curriculum, the need for a standardized, concise method of teaching the INQ theory to the elementary school teacher was evident.

Objectives

The objectives of this study were to design, produce and analyze a method of teaching the INQ concept, with the elementary teacher as the specified audience. Upon exposure to the teaching method, the elementary teacher should be successfully able to demonstrate competence in the following area:

1. Calculating percent of standards (% Std.) with given information. This term is defined, and the procedure given in the introduction of this report.

2. Calculating INQ (nutrient to energy ratios) values for individual nutrients in foods. The procedure for this calculation involves dividing the percent of standard for each nutrient by the percent of standard for energy.

3. Analyzing a food for nutritional content from food profile information.

4. Suggest complementary food choices using food nutrient profile information.

Design Approach

The design of the teaching system would encompass the following criteria: 1) content level would be suitable for participants with widely varying backgrounds and aptitudes; 2) the unit would serve as a primary delivery source so that additional contact with facilitators would be minimal; 3) it would be easily reproduced so that many identical units would be available for maximum distribution; 4) it would be small and easily transported. It was determined that a self-instructional slide-tape unit including an instruction-workbook met the above criteria.

Advantages of self-instructional units

Individualized instruction (which encompasses the self-instructional units) has been an important innovation in education, gaining in popularity since the late 1950's (Brown, Lewis and Harclerod, 1959). Curl (1967), made the following statement:

Automated self-instruction offers several advantages: instruction is consistent, while allowing for individual differences in aptitude; equipment may be left set-up; scheduling conflicts are all but eliminated; no student need feel "forced" into a humiliating mechanical confrontation before others; fewer instructors are needed. (Curl, 1967, p. 24.)

The self-instructional idea is an essential component of several successful teaching methods developed in recent years, including the personalized system of instruction (PSI) and various auto-tutorial systems.

The University of Kansas has developed an introductory course in nutrition using PSI, in which self-pacing is an important part. The course has been shown to be very successful, especially for slow learners (Cross and Semb, 1975). Burris (1976) reported very positive results from an audio-tutorial mathematics course, stating that there was an advantage to students proceeding at their own rate. Drop-out rates decreased as a result of the program. As a result of his thesis project, including an extensive literature review, Soulier (1970), concluded that a high level of achievement can be attained using the audio-tutorial approach to instruction. A self-instructional approach was used in this project, and was a factor in reaching this conclusion.

The self-instructional concept was considered to lend itself to the INQ theory because of the nature of the INQ material and the audience to which the unit is directed. The INQ deals with a ratio (nutrient density) which involves simple mathematical calculations as well as bar graphs. Those teachers who are not comfortable working with numbers and graphs (50 to 70 percent in

our sample) may wish to proceed at a slower pace and review the material several times. A self-paced unit allows for individual learning differences and provides for each learner to advance at his own rate without hindering the pace of the group.

Advantages of a slide-tape unit

Duane (1974) published a review article comparing various characteristics of the most commonly used types of media. He pointed out that the current emphasis is toward individualized instruction as opposed to large group instruction because of the economy and simplicity of materials and equipment. He stated the following benefits of using audio recordings and slides:

→ Tape recording equipment is readily available, inexpensive, portable, and simple to operate. (see p. 21 low cost compared to video 16mm etc)

Tape recorders are available which allow the user to control the rate of speed of a recorded tape.

Tape recordings are readily adaptable to either individualized instruction or large group instruction.

Cassette recorders are becoming the most widely used format since they are standardized in terms of container size, tape size, tape speed, are light weight, battery or A.C. operated and are self-threading.

Tape recordings provide high quality reproduction even after being played a large number of times.

Multiple tape copies are easily made.

Slides can be classified as having both flexible sequencing and flexible pacing.

Slides are useful for group or individualized study and can be sequenced and projected at a rate controlled by the user.

Slides can be produced using inexpensive cameras. (Duane, 1974, p. 35-36.)

Duane also pointed out the relative low cost of production of cassette tapes and slides, compared to other audio-visual media (16mm film, videotape, etc.).

The simplicity, low cost, and small size of slide-tape units meet the criteria that had been established for the INQ teaching module. Slide-tape units also meet the media selection assessment model proposed by Wilson (1974), of efficiency, effectiveness and cost. Wilson pointed out that often a less expensive medium is passed over for a costly media format, for example, using moving pictures when, as in the INQ presentation, movement is not essential to the information content.

Taking into account the numerous, successful programs that include self-instruction as a characteristic and the benefits of using slide-tapes as the medium, in agreement with Duane and Wilson--the decision was made to develop a self-instructional, slide-tape module to teach the INQ theory to elementary teachers.

Production of the Module

Production of the self-instructional slide-tape unit proceeded, using the following sequence: preparation of objectives, script and storyboard, preliminary testing and revision, and production of the instructional workbook.

Preparation of objectives

The objectives were developed to meet the broad goal of the unit--to introduce and familiarize the participant with the INQ

approach for communicating nutrition information. These broad goals were written in terms of behavioral objectives (Appendix A), and a copy was given to each participant involved in the didactic evaluation.

Preparation of the script

The script was written, incorporating fourteen of the guidelines suggested by Jones (1976) for writing Instructional Television scripts. These guidelines are listed below in italics, with a discussion of their incorporation into the development of the script for the teaching module included.

1. *Develop the rationale of the program.*
2. *Analyze subject matter.*

The above steps were discussed in previous sections.

3. *Assess entry behavior.*

A pre-test (Appendix B) was given to assess knowledge of subject matter.

4. *Develop strategy.*

It was decided that the subject must not be made "dull" or "too heavy" so a cartoon character was introduced with bright colors used as a background in an attempt to "lighten" the visual effect. At this point an elementary school teacher was consulted for an opinion on using a cartoon character for a factual presentation. Her opinion was that this approach would be successful. A cheerful melody was used as introductory and closing music, also to establish the light mood.

5. *Audience identification/participation.*

The specified audience is a population of elementary school teachers. The participant was instructed to take a self-test during the mid-point break to allow involvement and participation in the learning process.

6. *Relevancy.*

The subject matter was closely followed, with an attempt to explain why this method is valuable to the teacher in the classroom.

7. *Emphasis.*

Important procedures in the process were repeated three times and summarized.

8. *Pacing.*

Because the material is new and may be dealing in terms unfamiliar to many participants, it was determined that the pace would be slow, with much repetition and summarization. A break at mid-point in the sequence of slides provides for an opportunity to review, if necessary.

9. *Sequence of events.*

An attempt was made to introduce the material in steps on which further learning could then be built.

10. *Size of information increments.*

Learning increments were kept small.

11. *Repetition-review.*

Care was taken to repeat all main ideas and topics. Calculations were repeated three times and then reviewed. The material was also reviewed and summarized in the workbook.

12. *Cause and effect.*

Information was given as to why the method is desirable for incorporation in the nutrition education program, in addition to explaining the facts involved in the procedure.

13. *Response and reinforcement.*

The workbook self-test is the method whereby the student learning is reinforced.

14. *Evaluation of the program.*

This will be described in a later section.

Preparation of the storyboard

Upon completion of the script, sketches were drawn to illustrate concepts presented. This storyboard was then used in consultation with an illustrator to demonstrate graphics needed.

Production of the instructional workbook

The workbook had two functions--to instruct the participant in the set-up and use of the unit, as well as to provide definitions, summary calculations and a self-test with answers. By providing a complete summary of the material presented in the slide-tape unit, the learner need not be burdened by extensive note-taking during the presentation. The self-test and answers provide immediate feedback and allow for direct participation by the learner.

Preliminary testing and revision

The script for the audio portion of the presentation was recorded on tape and 8½ by 11 inch sketches representing the storyboard

were drawn for a preliminary test involving two medical dietetic students who were unfamiliar with the INQ approach. After viewing the unit, the students took the self-test from the workbook. This test is a measure of attainment of several important INQ concepts. Both students successfully completed the test, indicating that extensive revision would not be necessary. Minor wording and sequencing corrections were done at that time. After this preliminary testing, the illustrations and graphics were started.

The above sections described the steps taken in the production of the INQ module. These steps included preparation of objectives, script and storyboard, production of the instructional-workbook and preliminary testing and revision.

Pilot Tests and Revisions

Upon completion of the illustrations on posterboard, 35 mm pictures were taken and slides mounted. The slides were sequenced and placed in a Kodak Carousel slide tray, to be shown in conjunction with the tape recording of the script. The completed module was pilot-tested with two groups having varying backgrounds in order to determine if the content level were suitable for participants with a wide variety of backgrounds and aptitudes--one of the established criteria. The module was presented to a class of nursing students and a group of students and spouses with widely differing interests and occupations. The self-test from the workbook was administered to the groups after exposure to the unit. The participants answered all

of the questions correctly; however, they were allowed to refer to the material in the workbook. None felt the material was too difficult for them to master. Group discussion after the presentation was encouraged and written comments were solicited from the participants. Comments and discussions were complimentary to the project.

Minor changes and corrections in the graphics and script resulted from comments generated from this test, but the overall results were positive and encouraging; the decision was made to finalize the presentation in its present form. This finalization included producing a high quality audio tape and having the graphics reproduced for distribution to the nine schools, for use by the twenty-seven teachers involved in the project.

Description of Instrumentation

Testing of the teaching unit was done in two parts. An attitude survey was conducted with one group and a didactic test was conducted with a second group of subjects.

Attitude survey

The first evaluation procedure was an attitude survey conducted in conjunction with an INQ workshop for elementary school teachers in the state of Utah. The teaching modules were delivered to nine schools throughout the state to be viewed by the teachers participating. They then completed survey questions. The schools returned the surveys and modules before the workshop was attended. The survey, consisting of nine questions relating

to the module (Appendix C) was a part of a larger survey designed by an outside evaluator. There were 26 surveys returned, of the 27 participants in the program.

Didactic test

A test to determine the level of learning achieved was administered to the participants--a validation of the teaching module. An attempt was made to match the goals of the unit with at least one question. Performance on the test determined if the goals had been successfully met. A pre-test was administered to the participants before they were exposed to the unit (Appendix B). This pre-test was designed to determine if any of the subjects had prior knowledge of the Index of Nutritional Quality, as well as their level of nutritional and mathematical sophistication.

The pre- and post-tests were evaluated by eleven graduate students and faculty members from the Nutrition and Food Sciences department. After considering their comments and suggestions, it was decided that revision would be necessary--eliminating several "attitude-type" questions that would be duplications of the questions covered in the attitude survey.

The revised tests were then considered to be ready for the field test. Dr. Adkins, in the Department of Elementary Education agreed to allow his students, who were student teaching during the period of the field test, to participate in the study. A brief introduction to the INQ project was given to the class, as a group. At this time, the pre-test was administered and a copy of the goals

of the teaching unit was given to each participant with the information that the post-test would try to determine if these goals had been met.

Limitations

As the group of student-teachers would not be teaching the INQ concept to their classes, it could be questioned that their motivation would not duplicate practicing teachers involved with a nutrition education unit utilizing the INQ approach. In this case, the real value of a self-instructional module would be negated--that of allowing each subject to go at his own pace and review the unit as many times as necessary to master the concepts. If proper motivation were lacking, there might be the tendency for the student to expend the minimum time possible to complete the assignment. This would mean that in an actual teaching situation, the performance of the subject might be expected to be somewhat better than the results of this field test.

It was suggested that the respondents might be able to answer some of the questions from the post-test by chance or that it might be possible to answer the questions without viewing the unit. To determine if this were possible, seven subjects with diversified backgrounds were asked to take the post-test without previous exposure to the teaching module. This procedure should serve as a validation of the testing instrument.

CHAPTER IV

RESULTS

Restatement of Purpose

The purpose of this study was to review the literature and assess the need for new methods of nutrition education; study several new nutrition education methods; and develop, produce, and evaluate a unit to introduce the Index of Nutritional Quality to elementary teachers involved in nutrition education.

Statistical Analysis

The data were collected in two parts. The first procedure consisted of an attitude survey conducted by an outside evaluator. A Student's T test was used to test the significance of deviation from neutrality of the attitudes of the participants. The second procedure consisted of a didactic pre- and post-test. A tabulation of any correlation between the responses of the pre- and post-tests was compiled. An analysis of variance was used to test statistical significance of learning achieved after viewing the unit versus no exposure to the unit.

Results of the attitude survey

The attitude survey consisted of eight questions relating to the content of the teaching module. The respondents indicated their attitudes (or opinions) by checking the appropriate column

headed with five increments of agreement, neutrality or disagreement. This scale was given the numerical rating of 5 for "strongly agree," 4 for "moderately agree," 3 for "neutral," 2 for "moderately disagree" and 1 for "strongly disagree." In five of the eight questions, the positive (favorable to the unit) response was indicated by a high number. In questions 3A and 3B, the positive (favorable) response was indicated by a low number.

The null hypothesis, $H_0: \mu = 3$ was tested, using the Student's T test, to the 5 percent level of significance. The larger are the absolute values of T, the easier it is to reject the null hypothesis and accept the alternate hypothesis $H_A: \mu \neq 3$. The results of the statistical analysis are given in Table 1.

Table 1. Statistical results of attitude survey

| Question | Mean | Variance | T | $H_0: \mu = 3$ |
|--|------|----------|-------|----------------|
| 1. My reaction to a self-instructional approach to this material was favorable. | 4.00 | 0.88 | 5.44 | Reject |
| 2. The number of examples given was about right. | 4.04 | 0.68 | 6.43 | Reject |
| 3. I found myself going back frequently to review... | | | | |
| A. the slide tape presentation | 2.83 | 2.06 | -0.57 | Accept |
| B. the worksheet | 3.00 | 2.00 | 0.00 | Accept |
| 4. The self-test was a useful exercise in applying the skills taught. | 3.88 | 0.67 | 5.53 | Reject |
| 5. I feel reasonably comfortable with setting up the calculations. | 3.50 | 1.30 | 2.24 | Reject |
| 6. I could see a logical relationship between the initial slide-tape presentation and the self-instructional exercise. | 4.08 | 0.31 | 9.80 | Reject |

Rejection of the null hypothesis in questions 1, 2, 4, 5 and 6, indicates that the respondents are not neutral ($\mu = 3$) in their attitudes regarding the teaching module for those questions. By inspection of the means it can be determined that the attitudes are positive for these questions because the values are significantly greater than 3. The hypothesis was accepted in questions 3A and 3B. The mean was not significantly different from neutrality (3). The large variance indicates that some of the respondents had to review the material, while others did not.

Results of the didactic test

The pre-test was scored and the results are tabulated in Table 2. Responses indicating an unfamiliarity or an uncomf-
ability with a concept was considered to be a negative (-)
response.

Table 2. Number and percent of negative responses in pre-test

| Question | No of Neg (-) Responses | % of Neg (-) Responses |
|--|----------------------------|---------------------------|
| 1. I (have) (have not) heard of the INQ method. | 29 | 97 |
| 2. I (have) (have never) worked with the INQ method. | 30 | 100 |
| 3. I am (familiar) (unfamiliar) with nutritional terms as RDA. | 21 | 70 |
| 4. I feel (comfortable) (uncomfortable) working with numerical concepts. | 13 | 43 |
| 5. I (am) (am not) comfortable with bar graphs. | 15 | 50 |

Correlation between pre- and post-test. It was the purpose of the pre-test to determine if there were a correlation between a respondent's attitude or understanding of nutritional concepts, math, or linear graphs and learning achieved--evidenced by the performance on the post-test. The following relationships were found: (1) Of the total of sixteen incorrect answers for question 1A, 1B, 1C and 1D, thirteen were from people who had indicated that they feel uncomfortable with numerical concepts. (2) Question 4, which deals with food complementation using the INQ method was most commonly missed (77 percent). Of the seven respondents missing the question, six of them indicated an unfamiliarity with simple nutritional concepts.

Scoring of the post-test. It was the nature of question 1 that if an answer were incorrect in one part, the following parts would be incorrect also. If this occurred, only one answer was counted wrong. This allowed for one wrong answer to be counted wrong only once. This event occurred three times, and would have affected question 1C slightly. It also occurred that a problem was set up correctly, but the respondent made a mathematical error. Although this situation indicated an understanding of the concept, the answer was counted wrong. This occurred five times in question 1A and 1B and affected the percentages to the extent that if the answers had been counted as correct, 1A would have a total of 86 percent correct and 1B, 90 percent correct.

The post-test was hand scored by the experimenter, and the number of correct responses is tabulated in Table 3. A description of the concept that was being tested is listed for each question. See Appendix D for the actual questions asked to the subjects.

Table 3. Results of concepts tested in post-test

| Concept Tested | No of Correct Responses | % of Correct Responses |
|--|-------------------------|------------------------|
| 1A. Calculation of % of Std of nutrient | 24 | 80 |
| 1B. Calculation of % of Std of energy | 24 | 80 |
| 1C. Calculation of INQ value | 28 | 93 |
| 1D. Analysis of INQ value | 28 | 93 |
| 2. Relationship of INQ numerical value to bar graph | 28 | 93 |
| 3. Relationship of profile information to nutrient amounts | 27 | 90 |
| 4. Using INQ for food complementation | 23 | 77 |

Table 4 tabulates the results of the responses of subjects who had no exposure to the teaching module before they took the post-test. This was done as a validation of the post-test instrument.

Table 4. Results of concepts tested in post-test. Subjects had no prior exposure to the teaching module.

| Concept Tested | No of Correct Responses | % of Correct Responses |
|--|-------------------------|------------------------|
| 1A. Calculation of % of Std of nutrient | 1 | 14 |
| 1B. Calculation of % of Std of energy | 1 | 14 |
| 1C. Calculation of INQ value | 1 | 14 |
| 1D. Analysis of INQ value | 1 | 14 |
| 2. Relationship of INQ numerical value to bar graph | 4 | 57 |
| 3. Relationship of profile information to nutrient amounts | 2 | 29 |
| 4. Using INQ for food complementation | 3 | 43 |

An analysis of variance (Table 5) was computed to test the significance of the difference between the correct responses of participants who had, or had no, exposure to the teaching module. The exposure to the teaching module, then, became the treatment effect in the table. The F test value is significant at 1 percent.

Table 5. Analysis of variance between correct responses of subjects either having, or having no, exposure to teaching module.

| Source of variation | Degrees of freedom | Mean squares | F test value |
|---------------------|--------------------|--------------|--------------|
| Total | 36 | 4.47 | |
| Treatment | 1 | 76.049 | 31.43 |
| Experimental error | 35 | 2.42 | |

CHAPTER V
DISCUSSION

Statement in Support of Hypothesis

It was the conclusion of the researcher, based on the data collected as a result of this study, that the use of this self-instructional, multi-media teaching module will facilitate the learning of the Index of Nutritional Quality concept by elementary school teachers.

Discussion of Results

Attitude survey

The attitude survey represented the participant's opinion of the learning he achieved as a result of the teaching module--as well as an opinion of the unit itself. Questions 1 and 6 asked for a response about the subject's overall impression of the presentation of the material. The responses were generally favorable, indicating that the subjects felt good about the presentation. Questions 2, 3A and 3B and 4 asked for the subject's impressions regarding specific aspects of the presentation, the number of examples, the self-test, etc. The responses to these questions were more highly variable, but generally favorable, indicating that most of the participants found the unit to be "workable" and major revisions would not be necessary. The

response to question 5 supported the hypothesis that learning was achieved by the participants in this phase of the study. Seventeen of the respondents reported that they felt comfortable with setting up the calculations used in the Index of Nutritional Quality. This question asked the participants to subjectively evaluate the learning that they had achieved.

The favorable attitude of the participants, as indicated by the statistically significant (to the 5 percent level on the Student T test) positive responses on the attitude survey supported the hypothesis that the teaching module developed in this study was an effective teaching device. The participants overwhelmingly felt that learning had been achieved as a result of the teaching module.

Didactic test

Pre-test. The pre-test was devised as a method to measure previous contact with the INQ concept and to detect possible correlations in knowledge regarding math or nutrition with performance on the post-test. It was determined that only one person had heard of the INQ concept, and no one had worked with it. It was decided that the various interactions involved in proving statistically significant correlations between knowledge of math or nutrition and performance on the post-test would be too complex to be of use in this study--the figures for two interactions were reported in the Result section of this paper.

Post-test. To gain insight more objectively into the actual learning that took place, the second evaluation was devised for a different group than the attitude survey. Again, in support of the hypothesis, the results indicated that learning did take place. The goals that were to be accomplished were that each participant will be able to:

1. Calculate percent of standards with given information--this goal was tested by questions 1A and 1B. 88 percent of the participants answered the questions correctly. This indicated that the majority of the subjects did learn how to calculate the percent of standards, the desired goal.
2. Calculate INQ values--this goal was tested by question 1C. There was a 93 percent correct response to this question, indicating a very good achievement for this goal.
3. Analyze a food from food profile information--this goal was verified by question 3. 90 percent of the participants answered this question correctly. This was an important goal, actually the most important concept for the elementary teacher who must use food profile information in teaching the concept. The response indicated that a high level of learning was achieved.
4. Complement foods using food profile information--question 4 tested this goal. The correct response for the question was 77 percent. This was the lowest score of the test. The response rate was considered to be satisfactory, however. If other groups in future usage of the unit continue to score low in this area, the unit might be expanded in the complimentation section.

The scores for the post-test were all above 75 percent. This is considered to be a very good indication that the goals of the unit were achieved and learning did take place. This is particularly evident when the above scores are compared to the scores of the same test given to subjects who had not seen the unit (Table 4). The differences in the means of the scores were significant to the 1 percent level.

Statement of Contribution

It was felt by the experimenter that the module developed has met the established criteria of content suitable for persons of widely varying backgrounds; being suitable as a primary delivery source to avoid need of accompanying personnel; easily reproducible; small and easily transportable for inexpensive, convenient information dissemination; and has met the goals of learning that were pre-specified and listed in Appendix A.

The unit, including the slide-tape and the accompanying workbook would be a useful teacher education component in the field of nutrition education. Used to help to improve the knowledge and motivation of the elementary school teacher, the unit would thereby benefit the learning and, hopefully, the health of children in the United States.

Summary

A review of the literature dealing with nutrition education established that the following situations exist: (a) there is a

need for nutrition education at the elementary school level; (b) that elementary school teachers do not always have the background or motivation to meet this need for nutrition education: (c) new educational methods are needed that are easier to understand and more highly motivating.

The Index of Nutritional Quality (INQ), a nutrient density concept, was developed at Utah State University to answer the need for easily understood, motivating media, and has been considered successful in actual classroom situations. Up to this time the INQ method of teaching was introduced to interested individuals and groups by the various members of the INQ research group--a method that is expensive in time and travel expense, and lacks consistency. A less expensive, more standardized method of disseminating information about the INQ method was needed.

After consideration of the various types of media available, it was decided that a self-instructional slide-tape unit with an accompanying instruction-workbook would be a satisfactory teaching module.

The module was developed and tested as a part of this study, using both an attitude survey and a didactic pre- and post-test as evaluation instruments. The test statistics were significant to conclude that learning had taken place and the module was successful as a teaching device.

Recommendations

On the basis of the high level of achievement demonstrated by the participants in this study, it is recommended that the module developed be used as a teaching device for elementary educators in conjunction with the other instructional materials developed for the Index of Nutritional Quality Nutrition Education Project.

Because food complementation is a major area of importance in nutrition education and because the question on food complementation (Table 3, question 4) was the most often missed, further revision of the module might include expansion in this area. Further testing in an actual teaching situation would determine the necessity for this alteration.

As the content of the teaching module developed in this study is limited primarily to theory rather than application, it is suggested that the unit not be used singly, but rather as a part of a larger, more inclusive collection of media for use by both the teachers and students. These materials would then provide the knowledge and motivation for both teachers and students to gain nutritional information, using the Index of Nutritional Quality.

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APPENDIXES

Appendix AGoals of Teaching Module

The student will be able to:

Calculate percent of standards with given information

Calculate INQ values

Analyze a food from food profile information

Complement foods using food profile information

The student will be asked to take a quiz upon completion of the slide-tape to test attainment of the above goals.

Appendix BPre-Test Questions

1. I (have) (have not) heard of the Index of Nutritional Quality (INQ).
2. I (have) (have never) worked with the INQ method.
3. I am (familiar) (unfamiliar) with nutritional terms as RDA.
4. I feel (comfortable) (uncomfortable) working with numerical concepts.
5. I (am) (am not) comfortable with bar graphs.

Appendix C

Attitude Survey and Responses

| Question | Strongly Agree | Moderately Agree | Neutral | Moderately Disagree | Strongly Disagree |
|--|-------------------|---------------------|----------|------------------------|----------------------|
| 1. My reaction to a self-instructional approach to this material was favorable. | <u>7</u> | <u>15</u> | <u>2</u> | <u>1</u> | <u>1</u> |
| 2. The number of examples given was about right | <u>7</u> | <u>15</u> | <u>2</u> | <u>2</u> | <u> </u> |
| 3. I found myself going back frequently to review material... | | | | | |
| 3A. in the slide tape presentation | <u>3</u> | <u>6</u> | <u>6</u> | <u>2</u> | <u>7</u> |
| 3B. in the worksheet | <u>2</u> | <u>11</u> | <u>4</u> | <u>1</u> | <u>7</u> |
| 4. The self-test was a useful exercise in applying the skills taught. | <u>4</u> | <u>17</u> | <u>4</u> | <u> </u> | <u>1</u> |
| 5. I feel reasonably comfortable with setting up the calculations. | <u>3</u> | <u>14</u> | <u>5</u> | <u>1</u> | <u>3</u> |
| 6. I could see a logical relationship between the initial slide-tape presentation and the self-instructional exercise. | <u>5</u> | <u>18</u> | <u>3</u> | <u> </u> | <u> </u> |

Appendix D

Post-Test Questions

1. Assume that the RDA for niacin is 20 mg and the RDA for energy is 2000 Kcals.
 - A. Using the above information, find the percent of standard for niacin if the food contains 5 mg of niacin.
 - B. Find the percent of standard for energy if the food contains 100 Kcals.
 - C. Using the percent of standards that you have found, calculate the INQ value for niacin.
 - D. Is this food carrying its weight in niacin?
2. Using what you have learned about the Nutrient to Energy relationship, and using the energy line as a guide, match the nutrient lines to the INQ values for the following nutrients.

| NUTRIENT | INQ | NUTRIENT LINE |
|-----------|---------------|---------------|
| Energy | 1.00 _____ | |
| Protein | .50 a. _____ | 1) _____ |
| Vitamin A | 4.00 b. _____ | 2) _____ |
| Vitamin C | .25 c. _____ | 3) _____ |
| Thiamin | 2.00 d. _____ | 4) _____ |

3. Given the following food profile information about a food, list the nutrients that are deficient, those that are adequate and those that are abundantly supplied in that food.

| Nutrient | Inq |
|----------|------------|
| Energy | 1.00 _____ |
| Protein | 5.00 _____ |
| Vita A | 5.36 _____ |
| Vita C | 0.00 _____ |
| Thiamin | 1.25 _____ |
| Ribo | 3.75 _____ |
| Niacin | 0.00 _____ |
| Calcium | 1.01 _____ |
| Iron | 3.30 _____ |

a. Deficient:

b. Adequate:

c. Abundant:

4. From the following food profile information from two foods, pick the one that best compliments the food from question 3. Circle the letter of your choice and tell briefly why this is the best choice.

a.

| Nutrient | INQ |
|----------|------------|
| Energy | 1.00 _____ |
| Protein | 1.07 _____ |
| Vita A | 0.00 |
| Vita C | 5.76 _____ |
| Thiamin | 1.28 _____ |
| Ribo | 0.16 - |
| Niacin | 1.80 _____ |
| Calcium | 0.12 - |
| Iron | 1.92 _____ |

b.

| Nutrient | INQ |
|----------|-------------|
| Energy | 1.00 _____ |
| Protein | 2.54 _____ |
| Vita A | 0.00 |
| Vita C | 0.00 |
| Thiamin | 2.67 _____ |
| Ribo | 1.14 _____ |
| Niacin | 3.14 _____ |
| Calcium | 0.71 _____ |
| Iron | 28.11 _____ |