

THE REFINEMENT OF A PRETEST FOR BEGINNING
COLLEGE NUTRITION

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CHAPTER I

INTRODUCTION

Students enrolling in college today have varying abilities, backgrounds, and experiences. One of the principal problems posed is that of devising a method or methods that educators may use to meet the needs of each individual. To expedite the development of the student to his maximum, most colleges have admission testing programs which aim at ascertaining aptitudes, achievements, interests, and special abilities of each student. The time has passed when educators were willing to rely on the intelligence quotient as a measure for classifying college students. Other factors affecting performance are interest, motivation, persistence, successes, failures, and change.

Prediction accuracy can be increased by using a predictive composite composed of weighted high school grades and weighted admissions test scores. These must be weighted in relation to emphasis of college program, e.g., engineering places weight on mathematics and science. The aim of those using the term "predictability" to mean agreement between actual and predicted performance is to be able to predict a level of performance which can be used as one of the bases for a decision as to where a student should be placed. These decisions should help to cut the waste of repetition of subject matter already learned.

Educational evaluation as practised today can be divided into three areas: the evaluation of academic achievement, the evaluation of

aptitudes, and the evaluation of personal-social adjustment. Measure of performance or achievement does not measure qualities like motivation, interests and values, or student interaction with environment. When evaluation is based on academic achievement it includes those techniques designed to measure the degree to which most educational objectives have been achieved. It is with this area of evaluation that the author is concerned in this study.

Theoretically, a teacher can teach one student at a time more effectively than forty students at one time, because he can stress the parts in which the student is weak and go rapidly over the material the student understands. Acknowledging the fact that classes must contain more than one, it is desirable that those within a class be as nearly equal in strengths and weaknesses as possible. This is especially important in subjects in which some students have had previous instruction while others have had little or none.

A pretest for students enrolling in nutrition could fulfill the two main purposes of educational evaluation. The first is to help the teacher evaluate the degree to which educational objectives have been achieved and the second is to help him know his students to such a degree that educational experiences of students can be planned according to their backgrounds.

✓ The problem in this study was the refinement of an objective pretest for students enrolling in a beginning nutrition course. Cooksey (8) developed a one-hundred and twenty-five item multiple-choice pretest based on the application of the principles, generalizations, and facts in beginning college nutrition at Oklahoma State University in 1964. The conclusion was that before it could be used successfully

the areas of item weakness would have to be modified. The refinement of this pretest was subdivided in this study into the following steps:

1. The generalizations identified by Cooksey were reviewed to include current concepts of nutrition which are in agreement with recent research. The objectives were revised or restated.
2. Additional objectives and generalizations to more fully cover the content of this beginning nutrition course were included.
3. Item analysis was applied to each of Cooksey's questions and a method of computerizing calculations of r and discrimination and difficulty indices was developed. These calculations were performed on all questions, followed by a revision of all questions not meeting standards.
4. Additional questions in areas needing emphasis were formulated in an effort to establish greater validity and higher reliability coefficients than Cooksey had obtained.
5. The revised pretest was administered to undergraduate men and women at Oklahoma State University; item analysis applied; and calculations of discrimination and difficulty indices performed. The reliability was estimated and expressed as a coefficient of internal consistency.

Hypothesis

The major hypothesis underlying this study was that a pretest in beginning nutrition can be devised which will have content validity and coefficients of reliability of the test scores sufficiently high

to permit its use in testing incoming Freshmen.

Assumptions

In order to develop a pretest as one means of evaluation it was necessary to accept certain basic assumptions. Other terms for assumptions could be guidelines, rationale behind evaluation, principles for developing pretests, or premises. Whatever the current terminology, the assumptions or directions for building the hypothesis stated above included the following as being basic to the study.

The first assumption was that a valid pretest in nutrition could help advisors place students in appropriate sections of a beginning course and aid in placement of transfer students.

The second assumption was that education is a process which seeks to change the behavior of students and this behavior includes the way a student thinks, acts, feels, and reacts to other people or social situations. Human behavior is complex enough that it cannot be adequately measured by a single dimension and certainly this pretest was not intended to measure the final grade in the course. It was felt that such a pretest could motivate students to use and add to their present knowledge and could give some structure to studying for the course.

The third assumption was that the pretest would be based on application of principles, generalizations, and facts. These generalizations were compiled from recent textbooks, nutrition journals, and bulletins. The criteria for the questions included levels of thinking above the ability to recall actual facts. It was believed that they would measure comprehension, application, analysis, synthesis, and

evaluation.

The fourth assumption was that the pretest would give to teachers insight into needs for curriculum revision and for points of emphasis during the teaching of the course. This pretest could point to the educational experiences needed for transfer of knowledge from teacher to student.

Definition of Terms

Concepts are ideas that will enable understanding and discrimination. They incorporate comprehension, reflection, and generalization, but refer to a single idea.

Objectives are expressions of those things to be accomplished by students and should be expressed in terms of product rather than process. Educational objectives are goals towards which students progress and as such are a basis for measurement of student achievement.

Generalizations are statements which can be substantiated with evidence and which will apply to a number of problems. Usually they show relationship among concepts giving the cause, implications, and consequences.

The taxonomy of educational objectives has been built in the last decade to provide for classification of the goals of our educational system. Analysis of educational outcomes may be more thoroughly accomplished if categorized according to the behavior required. Since education is a process which seeks to change the behavior of students, the necessity for a common terminology arranged in a hierarchical fashion for designating various behaviors as resulting from the multitude of educational objectives has been eminent. In describing

behaviors, three domains have been established and the following definitions by Bloom et al. and Krathwohl et al. are used in this study:

1. The cognitive domain...includes those objectives which deal with the recall or recognition of knowledge and the development of intellectual abilities and skills (5, p. 7). They emphasize remembering or reproducing something which has presumably been learned, as well as objectives which involve the solving of some intellectual task for which the individual has to determine the essential problem and then reorder given material or combine it with ideas, methods, or procedures previously learned (25, p. 6).
2. The affective domain...includes those objectives which emphasize a feeling tone, an emotion, or a degree of acceptance or rejection. Affective objectives vary from simple attention to selected phenomena to complex but internally consistent qualities of character and conscience.
3. The psychomotor domain...includes those objectives which emphasize some muscular or motor skill, some manipulation of material and objects, or some act which requires a neuromuscular co-ordination (25, p. 7).

Item analysis is re-examination of each test item for the purpose of discovering its strengths and weaknesses. Ordinarily this analysis discloses two vital features of each test item--discriminating power and item difficulty.

Discriminating power is the ability of the test item to differentiate between the good and the poor student. This is expressed as an index to separate the discriminating items (those questions where

more high scoring than low scoring students answered correctly) from the nondiscriminating items (those questions where the proportions of high scoring and of low scoring students answering correctly were approximately equal).

Item difficulty refers to the percentage of students answering the question correctly. Much debate has ensued about corrections for guessing and formulae have been proposed so that at best this index is an approximation.

Reliability is strictly a statistical concept expressing consistency. An estimate of reliability refers to a specific kind of consistency and is not to be taken as a general measure. Expressions of reliability refer to results obtained with an evaluation instrument and not to the test itself since the variety of groups involved is great. In this study reference was made to the reliability of the test scores as administered to groups of high school graduates who had had no college nutrition. The consistency being investigated was expressed as a coefficient of internal consistency by the method used by Steelman (35) and Cooksey (8).

Content validity expresses the degree to which a test measures the subject matter content and behavior under consideration. A comparison of the test content to the universe of content and the behaviors to be measured is a desirable procedure and often a table of specifications is necessary.

CHAPTER II

REVIEW OF LITERATURE

Home economists in education are meeting the challenge of preparing students for life in the latter part of the twentieth century by recognizing that a major purpose of learning is to enable an individual to develop as an adequate person whose behavior is suitable to himself and to society. This element of self-evaluation emerges as one measurement in the total picture of education and requires instruments. There are a wide variety of possible ways of gathering evidence of student understandings. The objective test given as a pretest or during a course of study is a measuring technique that can be extremely effective.

The general topics to be reviewed were: home economics pretesting in various institutions; concepts, objectives, and generalizations in nutrition; methods of formulating valid tests with reliability of measurement; and some desirable characteristics of evaluation instruments.

Home Economics Pretesting in Various Institutions

Pretesting is not a new process as indicated by the fact that Army (2) as early as 1952 advised that pretesting should become a part of the usual classroom procedure in many homemaking classes. She pointed out that wiser decisions were made regarding curriculum content

after analysis of pretest scores. She contended that students learn by their mistakes and that discovery of what they do not know helps development of a favorable mind-set toward learning.

Remmers and Gage (33) concurred with the idea that pretests serve as stimulators of interest and that they enable students to distribute learning efforts according to the areas in which they are strong or weak.

A variety of measuring devices has been developed by home economists in an attempt to evaluate achievement more effectively. As early as 1921, Trilling and Hess advanced the theory that there could be no effective standardized tests in home economics because this area "is still vague in its purposes and really has no well-defined objectives" (41, p. 483). Since that time much has been done in defining objectives in all areas. By 1947, the American Home Economics Association was working with the Cooperative Testing Service of the American Council on Education for developing tests to measure student achievement in home economics. Both a foods and nutrition test and a textiles and clothing test were developed at that time (3).

At Oklahoma State University, the first recorded work toward developing a pretest was that done for a basic clothing course by Walsh (44) in 1959. An objective test was constructed and each item analyzed for content validity by comparison with expert opinion, text books, and directly with objectives of instruction. This test was not administered to preliminary tryout groups but was used over a period of years and revisions were made.

Also in 1959, Hoskins (23) developed a pretest in clothing for use in all the colleges in New Mexico offering home economics.

Generalizations, formulated from textbooks used in the first courses, were used as a guide to develop a paper-and-pencil test containing sixty multiple choice and eighty true-false items.

Witt (45) revised the written placement test in clothing at Oklahoma State University in 1961 and developed a station-to-station test to evaluate the students' manipulative and judgmental skills pertaining to clothing construction, selection, and care. Witt's study pointed to a need for evaluating different skills for placement in class, as a student who scored high on one problem in the test did not necessarily receive a similarly high score on a second problem. The recommendation was made that an evaluative device must be revised frequently if it is to continue to be effective.

In 1963, Gould worked on a performance pretest in clothing construction and studied the relationship between ranks of individuals on the performance tests and on the written test then being used by the Department of Clothing, Textiles, and Merchandising at the College of Home Economics at Oklahoma State University. This pretest was to be used as an aid in sectioning students enrolled in a basic clothing course. The author concluded that the test had merit for aiding in the placement of students but recommended that further studies be made to improve the performance test. Further she stated "Students' interest and achievement increase when they are placed in homogenous groups according to ability" (19, p. 18).

Steelman (35) developed an objective written and laboratory pretest based on aims and generalizations for a beginning college food preparation course in 1963 at Oklahoma State University. She listed objectives for the course categorized as to behavioral aspect

chart described by Tyler (42, p. 31).

Analysis of pretest scores for 138 subjects taking the theory section of the pretest and 115 students taking the laboratory section was made by Steelman. The test items were studied with the result that seventy-six per cent of the items on the theory section of the pretest proved to be discriminating and seventy-seven per cent of the laboratory pretest items were discriminating. Difficulty indices were calculated and the author recommended that the theory section of the pretest should have 150 discriminating items ranging in order of difficulty.

Cooksey (8) developed a 125 item multiple-choice pretest based on the application of the principles, generalizations, and facts in beginning college nutrition in 1964. The content aspect of the objectives of the course were scored for behavioral aspects in a chart similar to Steelman's (35). The test was administered to 137 students enrolled in beginning nutrition at Oklahoma State University at the first of the semester. Item analysis and calculations of discrimination and difficulty indices revealed that the pretest was reasonably valid with the test scores showing reliability coefficient of 0.84. Nevertheless, Cooksey concluded that the test could not be used as an exemption instrument because of areas of item weakness needing modification.

Since it is difficult with large numbers of students to review each pupil's cumulative record and learn his home background, it is frequently desirable to use a pretest at the beginning of a course. Gronlund said:

Pretests provide up-to-date information concerning the pupils' readiness for new learning activity and help identify areas of instruction which should be emphasized or deemphasized. Pretesting usually takes one of two forms: giving a test on the basic skills or concepts which are prerequisite to learning the material in the present course; or giving a test which covers the material to be taught in the course (20, p. 364).

Concepts, Objectives, and Generalizations in Nutrition

Tinsley and Sitton (38) defined concepts as ideas which students form in their minds in order to understand and cope with something in their experience. Concepts are not given by teachers because before a concept exists, the student must identify it and then accept and use it to make it his own. The concept may be composed of meaning and feeling which may or may not be expressed in words. These writers stated that concepts serve as systems for organizing subject matter, aids to thinking, and predeterminers of behavior in cognitive learning. Three necessary conditions for concept formation are perceptions, experiences, and reflections or thinking. The teacher provides opportunities for the students to perceive through seeing, touching, tasting, manipulating, and observing various processes and then discovering how these can be combined to bring about a synthesis of high value.

Barbour accepted the definition of DiVesta for process concepts as "mental images of processes by which goals and values are achieved" (4, p. 3). Further, she said that an example of a process concept is a generalization which indicates how an individual believes a goal or value can be attained. Her description of Mowrer's three principles of learning (association, conditioning, and law of effect) parallels later writings describing various behavioral aspects of learning. Mowrer divided the learning process into two distinctly different

parts: the one involving the central nervous system and the skeletal muscles, and the other taking place at the level of the autonomic nervous system involving response in the visceral and vascular aspects of the individual.

Sayers and Madden (34) stated that the act of learning had three aspects--the rational element which included the act of inquiry characterized by observation, weighing of evidence, and experimentation; the artistic; and the aesthetic.

Concepts refer to meanings, according to Gorow (18) and the student with a concept can not only discriminate but can also generalize. In testing for whether the student has a concept or not, the following methods were suggested by Gorow: definition, explanation in students' own words, example or illustration, selection of the best of several alternative statements defining or explaining, or selection of the best illustration among several.

Loree (31) gave much the same discussion on concepts as Gorow. He defined a concept as a generalization formed by abstracting some characteristics or critical attributes from a class of objects or events.

Objectives are statements of purpose expressed in terms of the student. During the past two decades considerable change in the formation and statement of objectives has taken place. In the earlier part of this century emphasis in instruction was on subject matter. In the fifties Army stated:

Slowly but surely, there is emerging a realization that both instruction and evaluation should be focused upon goals rather than upon content; upon the use people will make of subject matter than upon the subject matter itself (2, p. 13).

Tyler (43) reminded educators that learning is what the student does, not what the teacher does nor what the student is exposed to. He taught that learning experiences refer to the interaction between the learner and the external conditions in the environment to which he can react. He devised a graphic two-dimensional chart to be used to express objectives concisely and clearly with one dimension being the content area and the other the behavioral aspect.

Remmers and Gage said that evaluation and objectives are so much related that each objective must be defined in terms of the measures of its attainment. Their rules for formulating objectives are as follows:

1. Objectives should be worded in changes expected in the pupil rather than as duties of the teacher.
2. An objective should be put in terms of observable changes in the pupil between the beginning and end of his experiences in a defined segment of the educative process.
3. The terminology of the objective should be understandable; it should have its meaning defined in terms that pupils, parents, and other teachers can appreciate.
4. Each statement should be unitary and contain one objective only, to prevent confusion and facilitate ready identification of the objective.
5. Specific objectives should be grouped under the objective that is general for them (33, p. 33).

As the pendulum swung from emphasis on subject matter to use made of the content, the problem arose of establishing a common frame of reference for placing educational objectives. There was the need for

terminology that was clear and meaningful so that objectives could be classified permitting exact inferences about the kind of behaviors expected of students. These behaviors have been categorized into three domains--the cognitive, affective, and psychomotor.

Loree spoke of the multitude of educational objectives and skillfully described behaviors subsumed within each category of the taxonomy listing the three domains of behaviors. He was one of the first to be able to take the best of the beliefs of the extremes and to express a meaningful system. His list of teaching implications arising from discussion of each behavior in each domain for creativity is tantalizing to the inquisitive educator. The following is illustrative of Loree's analysis of the relationship of educational objectives in the categories of knowledge and comprehension to education for creativity:

1. Knowledge and comprehension may be thought of as "enabling objectives" for creative education. The person who has acquired information and has developed an understanding of concepts, principles, generalizations, ideas, and theories is in a better position to be creative than a person who has not.
2. Retrieval of information is particularly important to the process of creating. Hence it is of importance that children be aided in structuring or organizing the information they acquire so that it be more readily available for retrieval. Perhaps the students should be given some practice in structuring the information they acquire so as to improve his retrieval system. Possibly also, the student should be given practice in searching his memory for

information relevant to solution of problems.

3. The teaching procedure known as "learning by discovery" may be useful for objectives in the comprehension category. Through this procedure the child may learn to create new concepts or discover old concepts (31, p. 6).

An analysis similar to that of knowledge and comprehension may be made for the other categories of the cognitive domain--application, analysis, synthesis, and evaluation--and the objectives regarded as descriptions of problem-solving strategies or information-processing strategies.

The cognitive domain taxonomy was explained by Bloom et al. to be different from a classification in that "a taxonomy must be validated by demonstrating its consistency with the theoretical views in research findings of the field it attempts to order" whereas "...a classification scheme may be validated by reference to the criteria of communicability, usefulness, and suggestiveness" (5, p. 17). They organized the taxonomy to have six major classes as listed in the hierarchical order: knowledge, comprehension, application, analysis, synthesis, and evaluation. These are student behaviors which represent the intended outcomes of the educational process. Three levels of definition given in each taxonomy category were a verbal description or definition of each class and sub-class, a list of educational objectives which were included under each sub-class of the taxonomy, and third, the behavior appropriate to each category was clarified by illustrations of the examination questions and problems regarded as appropriate.

The affective domain was explained in the second handbook by

Krathwohl, Bloom, and Masia (25) eight years later. The five categories listed in the taxonomy of the affective domain were receiving, responding, valuing, organizing, and characterizing by a value or value complex. The authors' most difficult task was that of finding a continuum that would provide a means of ordering and relating the different kinds of behavior. But they structured a hierarchical order based on the principles of internalization. Little internalization characterized objectives in the receiving category and maximum internalization characterized objectives in the final category.

English and English defined internalization as "incorporating something within the mind or body; adopting as one's own the ideas, practices, standards, or values of another person or of society" (13, p. 272). To the authors of the handbook on the affective domain there are successive processes to internalization which are at first an incomplete and tentative adoption of only the overt manifestations of the desired behavior with complete adoption coming later. This continuum at successive levels is explained thus:

The process begins when the attention of the student is captured by some phenomenon, characteristic, or value. As he pays attention to the phenomenon, characteristic, or value, he differentiates it from the others present in the perceptual field. With differentiation comes a seeking out of the phenomenon as he gradually attaches emotional significance to it and comes to value it. As the process unfolds he relates this phenomenon to other phenomena to which he responds that also have value. This responding is sufficiently frequent so that he comes to react regularly, almost automatically, to it and to other things like it. Finally, the values are interrelated in a structure or view of the world, which he brings as a "set" to new problems (25, p. 33).

Krathwohl et al. (25) gave assurance that there was much less effort to collect evidence of growth in affective objectives than in the cognitive domain. Erosion of affective objectives was found in

many instances. As much emphasis was put on affective objectives as on cognitive objectives in the original statement. In the early years of the course small attempts were made to secure evidence of students developing in the affective behaviors. Within 10 to 20 years, there was a rapid dropping off of the affective objectives from statements about the course and an almost complete disappearance of efforts at appraisal of student growth in this domain.

Reasons for this shift in objectives from the affective to the cognitive domain were listed as follows:

1. It is easier to teach and evaluate cognitive objectives.
2. There is a hesitancy in the use of affective measures for grading purposes since
 - a. achievement, competence, productivity and such are regarded as public matters;
 - b. one's beliefs, attitudes, values and personality characteristics are more likely to be regarded as private matters.
3. A distinction frequently made between education and indoctrination in a democratic society is
 - a. education opens up possibilities for free choice and individual decision;
 - b. indoctrination is an attempt to force an individual to accept a particular viewpoint or belief.
4. The slow attainment of affective objectives makes it difficult to assign a grade in one semester or one year.

Other recent writers approach objectives with different terminology but much the same idea as previously discussed. Gronlund (20)

used the deficiency disease symptom approach in defining objectives, saying they were NOT actual subject matter identification, NOR lists of learning experiences of students, NOR descriptions of what one intended to do during instruction. Rather, objectives were to be stated in terms of the product as the reactions students are to make to subject matter content.

Gorow listed the following criteria for most useful statements of objectives which can be measured by testing:

1. Clear statement that indicates the "real goals" of instruction--those which will be tested.
2. Attainability in the course or unit.
3. Measurability.
4. Inclusion of the various kinds of learning which are essential (stated separately and explicitly).
5. Specification of the end results of learning--the abilities which students will have acquired when they have achieved the objectives.
6. Expression in behavioral terms--indicating what the learner will be able to do at the end of instruction (18, p. 7).

Gorow further stated that certain objectives would be appraised by means other than testing and that in order to measure the achievement of the objectives of a course, tests should include questions on various kinds of learning. He listed and defined three levels of achievement with knowledge being the lowest level requiring memory alone. Comprehension included knowledge but went beyond memory. Measurement of comprehension could be for concepts or meanings. The comprehension of complex ideas including principles, relationships,

generalizations, and other abstractions involving the reasoning processes is a kind of learning involving interpretation, discrimination, selection, and deduction. The third kind of learning was called application or transfer and is problem solving in a general sense.

Generalizations are usually statements of relationships between or among concepts. Dale (9) defined a generalization as a conclusion based on facts to the degree that a factless generalization is a contradiction in terms. He answered the writers of the articles in the early fifties by warning that the assumption that one does not need to know facts is an assumption that sound generalizations can be developed without them. He pointed to the need for classification of knowledge and called it a system of inter-related particulars. A specialist is able to structure his observations under a relatively small but powerful set of concepts or principles.

Hoover (22) described three levels of generalizations as a basis for evaluating degree of conceptual understanding held by students. The first-level generalization describes those that are definitions, descriptions, or classifications. The second-level generalizations describe those showing relationships among ideas and including more ideas than the first-level. The third-level generalizations are those that explain, justify, interpret, or predict. This level involves synthesis and evaluation.

Methods of Formulating Valid Tests With Reliability of Measurement

Travers (40) advocated that teachers must bear the main responsibility for appraising the outcomes of teaching and that it was important that evaluations made by teachers of their own work should

become less informal and more systematic. He said that the only evidence for favorable evaluation of teaching was a desirable change in students.

Wolfe (46) wrote regarding tests widely used in selecting, classifying, assigning and promoting students. He admitted that tests were usually merely tools, but since one cannot actually talk with each student there is a need for a quick, objective method of getting some kinds of information about what a person has learned and the skills he has developed. Tests work best when the traits or qualities to be measured can be precisely defined and not when measuring personality or creativity.

Before considering methods of formulating tests, the usefulness and limitations of various tests were reviewed by writers such as Garrett (17). He gave the four varieties of mental tests as intelligence, educational achievement, aptitude, and tests of various aspects of personality.

Chauncey and Dobbin (7) listed the ways of using tests to guide instructional planning and related these to the uses described for judging the capacity of students to learn. They advocated teacher adjustment of materials and methods to the students' capacities rather than the other way around.

The literature contained much discussion of the merits of various kinds of tests. Standardization of scoring essay tests was recommended since in many cases they catch students at "white heat" when they have studied facts and then applied them. Depth, subtlety, and creativity can be demonstrated more in essay tests than in multiple choice tests which seem to favor brilliant superficiality.

Link, on the other hand, listed the two advantages of objective tests as follows:

1. Covers a broad field of knowledge.
2. Provides a highly efficient method for determining students' knowledge of facts, as they cannot bluff, but have to know (30, p. 25).

Ahmann and Glock outlined three steps in construction of a paper-and-pencil achievement test, namely:

1. Identifying educational objectives that have verbal and mathematical aspects.
2. Developing tables of specifications reflecting the relative importance of the objectives.
3. Building the test items on the basis of the tables of specifications (1, p. 353).

The table of specifications indicates the number of test items to be devoted to each educational objective. Gronlund recommended that the first step in relating testing procedures to objectives is to develop this table, and then ask the question, "Are the pupil behaviors called forth by the test items the same as the behaviors defined by the specific learning outcomes?" (20, p. 50). A test measuring only knowledge still does not tell if the student can apply or use the knowledge. The table of specifications is a two-fold table which relates the objectives of the course to the subject matter content used to achieve the objectives.

Gorow (18) said that interdependent qualities such as validity, reliability, objectivity, difficulty, and efficiency could be used in judgment of the usefulness of achievement tests. Comments from

recent writers regarding the first two qualities only were included in this study.

A test is valid if it measures what it is intended to measure and this is the most important characteristic of an evaluative instrument, according to many educators (1, 10, 18, and 20). They listed four types or aspects of validity each of which can be defined as the degree to which an evaluation instrument accomplishes the aim associated with that type. Some tests are designed to meet more than one of the aims but more of the writers emphasized content and construct validity as the first two and then the two criterion related aspects-- predictive and concurrent.

Content validity--how well the test measures the subject matter and behavior under consideration--can be determined by making a comparison of subject matter in a test with a universe of subject matter content and behaviors to be measured. Content may be poorly covered in an essay or objective test unless the teacher provides for a good sampling of content, balanced with respect to coverage of the various parts of the subject. Construct validity--how test performance can be described psychologically--can be measured by experimentally determining what factors influenced scores on a test. Construct validity refers to the kind of learning specified or implied in the objectives.

Predictive validity--how well test performance predicts some future performance--can be measured by comparing test scores with some other measure of performance obtained at a later date. Lee (27) has worked with predictive validity using high school home economics grades and college grades. Concurrent validity--how well a test

performance compares with some other current performance--can be measured by comparing test scores with another measure of performance obtained at approximately the same time.

The teacher is concerned with level at which a test is valid and the validity is specific to certain students with certain experiences. Herein arises the quality of reliability which provides the consistency which makes validity possible. Coefficients are used to specify the type of consistency being investigated and Gronlund warned:

Treating reliability as a general characteristic can only lead to erroneous interpretation. It is possible for test scores to be consistent in one respect and not in another (20, p. 80).

A coefficient of stability can be estimated by giving the same test twice to the same group with a specific time interval between the tests ranging from several minutes to several years. A coefficient of equivalence can be estimated by giving two forms of the same test to the same group in close succession. A coefficient of stability and equivalence can be estimated by giving two forms of the test to the same group with an increased time interval between the forms.

A coefficient of internal consistency may be determined by two different methods. The split-half method of estimating reliability involves giving the test once and scoring two equivalent halves of it. Correction of the reliability coefficient to fit the whole test is by the use of the Spearman Brown formula (1). The Kuder-Richardson formula (6) may be used after scoring the total test.

Davis (10) stated that the basic requirement for measurement is defining the property or the characteristic to be measured. A pretest is defined as an examination given at the beginning of the school year or other teaching period to find what knowledge, skills, and

understandings students already possess in the subject matter to be taught. Whether building a pretest or examination for a certain unit of study, it is essential that a teacher have the purpose clearly in mind before outlining the material that needs to be covered to accomplish that purpose. Despite great care in writing, criticizing, and rewriting items, some of them prove unsatisfactory in actual use. An item analysis will identify those items that are too easy or too hard and those that do not discriminate between pupils who possess a large amount of the ability or knowledge being tested and those who possess little. This information can guide the teacher in revising items for re-use.

Item analysis procedures for more careful test construction are of a wide variety and usually yield two kinds of information. Such an analysis provides an index of item discrimination and an index of difficulty. Ahmann and Glock (1) stated that the use of item analysis could serve two purposes with the first being a provision of information concerning problems encountered and the second being that of diagnosis. By examining data from item analysis, the teacher can detect learning difficulties of individual students, or the class as a whole, and plan more suitable remedial programs.

Davis (10) gave in detail methods of using the proportions of success determined by comparing the responses of testees in the upper 27 per cent of the total group on each item with the testees in the lower 27 per cent of the total group. He stated that the most satisfactory relationship for internal-consistency item-analysis purposes was the biserial correlation coefficient between each item and the total score, excluding the item in question. The shortest

method for arriving at a satisfactory statistic was described in his bulletin (11) and search of the literature confirmed that this system is still the most accurate for expressing numerically a discrimination index and a difficulty index.

The computation of the product moment correlation coefficient was defined by Davis in Lindquist's book:

Interpretation of the product moment correlation coefficient assumes the relationship between the two sets of scores can be represented by a straight line and that the scores are expressed in units that measure equivalent increments in the variable tested (29, p. 268).

The equivalent values of product-moment r yield discrimination indices from 0 to 100 to reflect the true relationship between the psychological functions measured by the time and the total score used as a criterion.

Kelley (24, p. 17) found that by using the upper and lower 27 per cent of the population tested, the ratio of the obtained differences to its standard error is a maximum, and furnishes the optimum point for making the most precise estimates of the discrimination values of items in the pool.

Flanagan compiled a short method of obtaining item validity and item difficulty indices using a chart based on Kelley's finding. Flanagan said that his table "provided a simple means of determining which ones of a group of experimental items should be included in the final form to obtain maximum reliability coefficient for the finished test" (15, p. 680). Flanagan explained that the use of this chart, using only one-half of the cases and lumping these cases together into only two groups would give much less accurate results than the more usual correlation coefficients. He gave evidence of work

conducted to show that results obtained from this chart had been found to be satisfactory approximations.

A table for estimation of correlations based on the upper and lower 27 per cent of the group was compiled by Thorndike (37). This was a table of the values of the product moment coefficient of correlation in a normal bivariate population corresponding to given proportions of success.

Ahmann and Glock (1) showed a much more simplified method for determining the difficulty and discrimination indices and pointed to several serious limitations in the use of their techniques. The problems presented by the internal-consistency method were listed as:

1. This method is suitable for tests containing items that measure somewhat the same mental functions.
2. The item analysis is frequently based on a small number of pupils and is thus based on limited evidence.
3. Results are more relative than some teachers realize.

Some Desirable Characteristics of Evaluation Instruments

Stufflebeam (36) has stated that evaluation is the process of relating antecedent conditions and processes to outcomes, and outcomes to objectives. This necessitates the establishment of objectives for a course and subsequently a plan for various methods to determine the extent to which the objectives are achieved. After measurement, the outcome should be defined so as to uncover the functional relationships between outcome and process variables. This should enable one to make better decisions as to methods and practices that should be initiated, continued, or modified in order that the students may be given every

chance to learn.

Tyler (42) listed four steps in the rational planning of instruction. Objectives formed in the mind of the teacher but stated in terms of student behavior preceded determination of content and learning experiences most likely to attain these changes. The third step was an organization of learning experiences so that the cumulative effect would efficiently bring change and fourth, the appraisal of the effects of the learning experiences.

More recent writers have emphasized the formulation of evaluation devices concurrently with formulation of objectives. Gronlund (20) said that ideally, plans for evaluation are made at the same time instructional plans are formulated. Evaluation procedures determine functional goals of instruction. Objectives should be stated in terms of product rather than process. The question to be kept in mind is that of what the students are able to do at the end of a course that they could not do at the beginning. Evaluation can help in clarifying the goals of learning, understanding the learner, motivating learning, increasing retention and transfer of learning, and diagnosing and remedying learning difficulties.

It is desirable that evaluation processes in some way might facilitate motivation. Many current writings on the subject of pre-testing pointed to the tendency in the past to overemphasize content details, specialized vocabulary, and specific factual information to the neglect of generalizations, understandings, and their application. Loree recognized this weakness but paradoxically saw the necessity of the first step in the cognitive domain--knowledge or acquisition of information. As an illustration of this theory Loree said:

It seems fairly clear that the student does not have to be creative in order to attain a knowledge objective. The student merely memorizes, and that is not creativity. But it would be wrong to conclude that knowledge objectives are irrelevant to education for creativity. To be creative in any field of endeavor it is necessary to know something about the field. The paradox is that immersion in one's subject is a prerequisite to creative thought, yet our knowledge of current ideas in a field may blind us to new ones. Thus, while you do not have to be creative to obtain knowledge, it is difficult, if not impossible to be creative in a field unless you do attain knowledge (32, p. 3).

In addition to motivation by provision of immediate, attainable goals toward which to work, tests may provide knowledge of learning processes. Link postulated:

If questions are well-chosen and tests well-constructed, they can help students learn how to organize, analyze, and judge ideas and concepts; how to sort relevant details from irrelevant ones; and how to think critically about the possible relationships in the materials they have studied. The tests are also likely to enable students to generalize about the importance of a course or even the value of education itself (30, p. 23).

To avoid the use of tests as tools only, the need arises for integrating evaluation and motivation. Dressel (12) reported that the one thing having more to do with the encouragement of integrative growth than any other single factor was the extent to which a student perceived his own personal pattern of educational experiences as interrelated among themselves and as related to the problems and experiences he was encountering at the time, both in formal education and outside. It is hoped that a pretest administered either during orientation or at the beginning of a nutrition course would point out areas of insufficient knowledge to the student and help motivate or stimulate his curiosity.

Regardless of the quality of various evaluation instruments it is well to note that few general statements can be made regarding any one

test. The aims of evaluation methods are numerous and varied, with certain similarities and dissimilarities. Ahmann and Glock divided the aims of evaluation methods into the four categories:

1. To determine how well a pupil performs today in a certain type of situation or subject matter, a cross-sectional sample of which is present in the evaluational instrument.
2. To predict a pupil's behavior in the future.
3. To estimate a pupil's present status with respect to some characteristic not directly evaluated by the instrument.
4. To infer the degree to which a pupil possesses some trait or quality that is assumed to be reflected in the results yielded by the evaluation instrument (1, p. 293).

The necessity for adaptation of the instrument to the situation and for strict adherence to caution in the use of results in evaluation was emphasized by Wolfle (46). He said that whether the results would be valuable, meaningless, or even misleading depended partly on the tool itself but largely on the user. All predictions of future performance are based on some knowledge of relevant past performance and how well the predictions will be validated by later performance depends upon the amount, reliability, and appropriateness of information used and on the skill and wisdom with which it is interpreted.

It is generally agreed that good teaching and consequently good evaluation must include three interrelated but distinguishable elements: liberal education, scholarly knowledge of the subject to be taught, and professional education. To attain design of an evaluation instrument measuring these elements requires study and research. The following statement by Woodring was taken by the author as an

objective stated in terms of student behavior:

The liberally educated man is articulate both in speech and writing. He has a feel for language, a respect for clarity and directness of expression, and a knowledge of some language other than his own. He is at home in the world of quantity, numbers, and measurement. He thinks rationally, logically, objectively, and knows the difference between fact and opinion. When the occasion demands, however, his thought is imaginative and creative rather than logical. He is perceptive, sensitive to form, and affected by beauty. His mind is flexible and adaptable, curious and independent. He knows a good deal about the world of nature and the world of man, about the culture of which he is a part, but he is never merely "well informed". He can use what he knows, with judgment and discrimination (47, p. 51).

CHAPTER III

METHOD OF PROCEDURE

The objective in this study was to develop a pretest that could be used as a tool in evaluation. Since evaluation is not a collection of techniques nor tools, but a process of determining the extent to which educational objectives are achieved by students, it is important to clarify what is to be evaluated. The techniques should be selected in terms of the purposes to be served. Various procedures are necessary to provide even limited evidence on some aspects of student behavior. The use of evaluation instruments requires an awareness of their limitations as well as their strengths. A great deal of discretion in interpretation of results is demanded to avoid misuse of tests.

This chapter deals with the development of the nutrition pretest, containing 100 multiple choice items, each composed of a stem and four distracters. The components of this problem can be discussed under the following headings: (1) the study of the pretest prepared by Cooksey (8) in 1964 with a review of her materials used in construction; (2) the statement of objectives for a beginning nutrition course as it is being taught currently; (3) the revision and addition of generalizations to be used as a basis for devising test items; (4) the construction of a table of specifications for the test; (5) an item analysis of the 125 questions given to 117 students in 1964 with determination of difficulty and discrimination indices; (6) construction

of 56 test items, 35 to be used as replacements for those in the first test that lacked proper discriminability; (7) administering the 150 item test to undergraduates with no college nutrition courses to obtain scores to be analyzed for reliability; and (8) repetition of item analysis in the new test.

Study of Cooksey's Pretest

The acquisition of an understanding of objectives, concepts, and generalizations was the first step for the author. The changes in terminology and the shift of emphasis from measurement of solely behavioral aspects of objectives to a combination of content and behavioral aspects necessitated revision of material.

Examination of the methods of test analysis by Cooksey and a comparison with methods used by others working in evaluation yielded satisfaction in the accuracy of the method used in this problem.

Development of Statements of Objectives

Objectives establish direction in teaching-learning situations, but are stated in terms of learning outcomes. The restatement of Cooksey's objectives came as a consequence of the author's familiarity with the content of the beginning nutrition course at Oklahoma State University due to teaching several sections of it for the past three semesters. The use of a new textbook and the writing of a syllabus to be used in the course were part of the author's preparation for serving as coordinator among the teachers of this multiple-section course.

These experiences formed background for the development of

statements of objectives and establishment of methods of evaluation simultaneously as recommended by many educators (1, 18, 20, and 41).

To check the adequacy of the objectives the inclusion of all logical goals of the course was important. The danger of being overzealous in the inclusion of too much subject matter was great. Limitations of a two-hour beginning course were kept in mind and restrictions were made on content. Current association with students enrolled in multiple sections of beginning nutrition was valuable in enabling one to be more realistic in terms of abilities of the students and the time and facilities available. The selection of pertinent goals was also implemented by attempting to make the objectives in harmony with the general goals of the Food, Nutrition and Institution Administration Department and the Division of Home Economics at Oklahoma State University.

An attempt was made to ascertain that the objectives were consistent with sound principles of learning. Four of these are the principles of readiness, motivation, retention, and transfer. The final criterion for objectives was that they be stated clearly in terms of changes in student behavior. They should indicate what the student is like and not what the teacher is going to do nor the subject matter content to be used. Reconciliation of the two criteria just mentioned required practice.

The revised set of objectives are in the appendix.

Revision and Addition of Generalizations

The relationship of facts and principles to problems other than the one experienced at the time of initial learning is incorporated in

a well-stated generalization. Learning to look for and see this relationship is a behavior and one that may be called application by some educators and transfer by others. The careful teacher will determine the generalizations necessary for the students to solve their problems. The use of a number of illustrations or examples is necessary to reach the scope of all student experiences so that each one may have a frame of reference.

A set of generalizations was developed from statements in recent textbooks (6, 14, 16, and 28) using those of Cooksey (8) where it seemed plausible since it was desirable to use the same questions whenever the discriminability was satisfactory. These generalizations served as the framework for the formulation of the test items. The list of generalizations is included in the appendix.

The Table of Specifications

A table of specifications assists the test maker in the same way that a blueprint serves a carpenter. It is a two-way chart relating the desired learning outcomes to the course content used to bring about those behavioral changes. The major areas of content are listed down the left of the table and the objectives may be listed across the top. The numbers in each of the cells in the table indicate the number of test items to be devoted to each area of content and each type of objective. This number may be expressed as a percentage of the total number of questions.

A means of determining that a test is a valid measure of the objectives and course content is the use of a device providing a systematic procedure such as the table of specifications. This

procedure is helpful to assure a representative sample of student behavior in each of the areas to be learned. The importance of such a table is emphasized by Ahmann and Glock (1) and Gronlund (20).

Preceding the formation of the table of specifications, the author prepared a content and behavioral aspect chart as described by Tyler (42), but terminology developed by Bloom (5) and Krathwohl, et al. (25) was used. Bloom, Krathwohl, and coworkers established the two domains that were broken down into three behaviors which permitted determination of a numerical value for the table of specifications. Much of the determination of the behavioral aspect of a test item seemed arbitrary, but the figures for the content as shown in the table of specifications were accurately tabulated. For conciseness, and because the author felt the line of demarcation between behavioral aspects to be nebulous, the behavioral changes in the objectives were summarized collectively under the two domains--cognitive or affective.

The behavioral-content chart of objectives and the table of specifications are included in the appendix.

Item Analysis With Determination of Difficulty and Discrimination Indices

The quality of each test item can be determined by analyzing the students' responses to the question. This provides a basis for restating the stem and the distracter, for eliminating clues, and for remedying other technical defects. There are various procedures for the item analysis but in general the method employed in this study is the one demonstrated in current works on testing (1, 8, 18, 19, 20, and 35).

After Cooksey's test had been administered and scored, the papers

were ranked in order from the highest to the lowest score. Only those test papers were analyzed in which all items were answered.

Method of determination of the upper and lower groups varies with some workers choosing the upper and lower halves, others the upper and lower thirds, and still others the upper and lower 27 per cent. In any of these cases, the middle group is discarded. The use of the total test scores as the criterion for classifying students into upper and lower groups, followed by the use of these groups to determine an index reflecting the discriminating power of individual test items, is the internal consistency method of determining indices of discriminability.

In this study, the item analysis of Cooksey's test consisted of comparing the responses of students in the upper 27 per cent of total group with those in the lower 27 per cent. Since 117 complete answer sheets were available, this meant 32 subjects in each group.

The procedure of analysis of these two groups was as follows:

1. For each item, the number of students in the upper and lower groups who selected each alternative or distracter was tabulated. This tabulation was made on a data sheet. This form is shown in the results. The correct response was marked.
2. The correction for guessing was made in the same mathematical manipulation used for establishing a proportion of successes in each group. This proportion was derived by applying the following formula (11, p. 6):

$$P = \frac{R - \frac{W}{(K-1)}}{N}$$

P = Proportion

R = The number of testees that answer the item correctly

W = The number of testees that answer the item incorrectly

K = The number of choices in the item

N = The number of testees answering the question.

3. The discriminating power of each item refers to the degree to which it discriminates between students with high and low achievement and is expressed as an index. There are several methods for estimation, but the steps followed in this study for expressing a discrimination index were:
 - a. The product-moment coefficient of correlation (r) in a normal bivariate population corresponding to given proportions of success was determined by using Thorndike's Table (37, p. 345). It was entered on the left with the proportions of successes in the 27 per cent scoring lowest on the continuous variable and from the top with the proportion of the successes in the 27 per cent scoring highest on the continuous variable. This short method of obtaining item validity was explained by Flanagan (15, p. 680).
 - b. If odd rather than even proportions were obtained, an interpolation for the appropriate correlation coefficient was required.
 - c. The r value was used to enter the Discrimination Indices Table prepared by Davis (11, p. 13) yielding an index of discrimination that was recorded for each item.
4. The difficulty index is an estimate of the difficulty

indicated by the percentage of students who get the item right. There are numerous arguments for and against correcting for guessing (29, p. 266). In this study, a correction was made and the difficulty index expressed by the following procedure:

- a. The proportions of successes of the high and low groups derived in step 2 were summed and divided by two.
- b. The level of item difficulty was determined by entering the Difficulty Indices Table prepared by Davis (11, p. 38) with the average proportion derived in step 4 (a). This yielded a difficulty index that was recorded for each item.

A discrimination index of 15 was accepted as the minimum level for retaining items for the revised test. An item with maximum positive discriminating power would be one where all students in the upper group answered the item right and all the students in the lower group answered the item wrong. This would result in an index of 100. An item with no discriminating power would be one where an equal number of students in both the upper and lower groups answered the item right. This would result in an index of zero. Any negative value indicates that the test item discriminates to some degree in the wrong direction and is not satisfactory as a test item. Before such items were discarded, the difficulty index was scrutinized to help in diagnosis for remedial measures for the distracters.

The discriminating power of an item is influenced by its difficulty. Ahmann and Glock (1) make the recommendation that tests include only those items with mid-range of difficulty, between 40 and

70 per cent. Cooksey (8) used the "ideal" range between 25 and 70, whereas Steelman (35) defined the ideal range as between 30 and 70. Although the smaller the index, the more difficult the item, items falling below the set minimum need not be eliminated provided they are within the limits of suitable discriminability (11).

The reliability of the results of the test scores was calculated by an approximation formula taken from Garrett (17) that follows:

$$r_{11} = \frac{n t^2 - m(n-m)}{t^2 (n-1)}$$

r_{11} = reliability of the whole test

n = number of items in test

t = standard deviation of test scores

m = mean of test scores.

This complete method of mathematical procedure was worked into a computer program for the Oklahoma State University Computing Center IBM 7040 machine. The tables described in this method and the formulae for proportions of success, for standard deviation, and for reliability were outlined for programming. Careful checks were run to ensure the computerized method being the correct method according to that used by Steelman (35) and Cooksey (8).

Construction of Test Items for Replacements and Additions

The listing of the discrimination indices by items enabled the author to identify and eliminate those questions in Cooksey's test with an index below 15. There were 35 or 28 per cent which fell in this range. In some cases it was possible to revise the question by looking at the item analysis. This revealed the effectiveness of the

distracters by telling whether the students in the upper or lower groups chose the correct answers.

To illustrate, a sample of the type question in Cooksey's test that had a low discriminability (discrimination index of 3) is given:

Vitamin D is called the "sunshine" vitamin because

- (1) it is given off by sunlight and is later absorbed by the body.
- (2) exposure to sunlight activates a substance under the skin and converts it to vitamin D.
- (3) heat produced by the sunlight triggers the synthesis of vitamin D in the body.
- (4) the rays of the sun produce a precursor of vitamin D in green leafy vegetables.

Nine of the top 27 per cent of the students chose distracter (1) as the best answer; 13 chose the correct answer (2) giving a proportion of .21 answering the item correctly when a correction-for-guessing formula was applied to the data; one chose distracter (3); and nine chose alternative (4). Nine of the lower 27 per cent of the students chose distracter (1) as the answer; four chose the correct answer (2) giving the proportion of .17 with the correction-for-guessing; seven chose alternative (3); and 12 chose distracter (4). The low discrimination index of three indicated that something was wrong with the statement in the stem or in one of the distracters.

Examination of the numbers who answered each distracter revealed that (1) is not a good distracter since "a good distracter is one that attracts more students from the lower group than the upper group", according to Gronlund (20, p. 212). Alternatives (3) and (4) did attract more in the low group than in the high group and consequently were used again.

All questions with distracters that did not entice any students, making the item a true-false statement, were examined for rewording.

Those with a difficulty index below 25 and above 70 were considered for revision.

The actual construction of the multiple-choice questions to bring the total number for the revised test to 150 was made more effective by the author being enrolled in the course in Evaluation taught by Dr. June Cozine, Head, Department of Home Economics Education. Numerous assignments consisted of construction of various kinds of questions for evaluation. The author was fortunate to have Dr. Cozine's suggestions as to better ways of stating the stems and distracters of many of the questions added to the test.

The criteria for constructing multiple-choice questions compiled by Steelman (35, p. 25) supplemented with rules from recent writers (1, 18, 20) were used in this study.

The test was lithographed on letter-size paper with the stem being followed by the four distracters in succession. They were numbered and the first word of each distracter was not capitalized unless a question mark had followed the stem. If the stem was completed by a phrase in the distracter, there was a period at the end of each stem so as to give no clues. If the stem was a question, the distracters were capitalized and no periods used unless the distracter was a sentence by itself.

Administering the Test

The cover page of the test consisted of directions for the examiner as well as general directions telling the students that all questions must be answered. Page 2 had specific directions about marking the answer sheet with the best answer and asked the students

not to write on the question sheet. Scrap paper for figuring was furnished the students and they were asked to sign a numbered sheet, giving their addresses. The number was written on the answer sheet and students were notified of their scores. The answer sheet contained four columns with the number of the question followed by numbers (1), (2), (3), (4) to be marked.

The test was offered each day for one week during the summer session at Oklahoma State University. All undergraduate men and women who had not previously enrolled in a Nutrition class were eligible. Their aid had been solicited by the author and her adviser during their orientation classes, but none of their regular class time had been available for testing. The students were allowed as long as they needed to finish the test since an item analysis was to be done. The time required ranged from 45 minutes to 75 minutes.

Analysis of the Revised Test

The number of volunteers for the revised test was only 47, but it was decided to score and perform an item analysis on that number with plans for administering the test to sections of the beginning nutrition class later.

The procedure outlined for analyzing Cooksey's test was repeated with the upper 27 per cent and lower 27 per cent of the scores being used for the item analysis. Discrimination and difficulty indices were determined for each item, and the coefficient of reliability was calculated.

CHAPTER IV

RESULTS AND DISCUSSION

Analysis of Pretest Scores

The distribution of test scores on a percentage basis for those students taking one of the two tests is presented in Table I. The mean and standard deviation of the Cooksey test scores were 75.97 and 13.96, respectively, whereas for the revised test they were 83.19 and 15.7.

The mean expressed in percentage for the Cooksey test was 60.77 and for the revised test it was 55.5. The median for the revised test expressed in percentage was 54.7 and the mode was 54.0. The arithmetic mean is a measure of central tendency. In the instances in which the test scores are for all practical purposes normally distributed, the arithmetic mean corresponds closely to these other measures of central tendency.

The coefficient of reliability of the test scores as measured by the same formula increased from .84 for the 125 item test to .86 for the 150 item test. It must be remembered that in each instance the reliability of the test scores was being estimated from a single administration of a single form of a test.

Analysis of Test Items

The distribution of the estimation of the item discriminating

TABLE I
 DISTRIBUTION OF SCORES ON A PERCENTAGE BASIS FOR THOSE
 STUDENTS TAKING ONE OF THE TWO TESTS

Score Range	Frequency 1964 Test ¹	Frequency 1967 Test ²
%		
86.0 - 82.1	2	1
82.0 - 78.1	5	0
78.0 - 74.1	10	1
74.0 - 70.1	7	2
70.0 - 66.1	8	3
66.0 - 62.1	24	3
62.0 - 58.1	19	9
58.0 - 54.1	14	5
54.0 - 50.1	6	11
50.0 - 46.1	6	2
46.0 - 42.1	9	6
42.0 - 38.1	6	1
38.0 - 34.1	0	3
34.0 - 31.2	1	0

¹For the Cooksey pretest with 125 possible points

²For the revised pretest with 150 possible points

power of the Cooksey and the revised pretest is presented in Table II. A low index of discriminating power does not necessarily indicate poor test items and does not indicate elimination until the reasons for the low index are examined. There is the possibility that the test item represents an area receiving little emphasis. Rather than remove all items with low discriminability, the teacher is well-advised to examine the objectives--both content and behavioral aspects.

Those items with a discrimination index below 15 were examined and studied for improvement, but were not automatically eliminated. There were 35 items or 28 per cent in Cooksey's test and 49 or 32.6 per cent of the items to be examined in the revised test.

The item difficulty is another factor which influences the discriminating power of an item and the distribution of the difficulty indices for both tests is shown in Table III. Those items at the 50 per cent level of difficulty make maximum discrimination. It can be seen that in the Cooksey test, the excellent range (from 40 to 59) included 58 of the items or 46 per cent. In the revised test, the excellent range included 63 of the items or 42 per cent.

Cooksey considered the "ideal" range for difficulty indices to be 25 to 70 which would include 92 per cent of the items; and in the revised test, 84 per cent of the items would be in the ideal range.

Revision of Test Items

The information for comparison of the responses to each distracter of the two groups taking the tests was tabulated for examination of results and for further improvement of the test. A comparison of results of item analysis of the Cooksey and revised pretest is

TABLE II
 DISTRIBUTION OF THE DISCRIMINATION INDICES¹ BASED
 ON THE UPPER AND LOWER 27 PER CENT OF STUDENTS
 TAKING THE TWO TESTS

Discrimination Range	Frequency 1964 Test ¹	Frequency 1967 Test ²
70 - 74	1	5
65 - 69	0	0
60 - 64	3	6
55 - 59	2	8
50 - 54	11	4
45 - 49	7	5
40 - 44	4	10
35 - 39	14	14
30 - 34	11	8
25 - 29	17	16
20 - 24	9	3
15 - 19	11	22
10 - 14	8	9
5 - 9	7	11
0 - 4	9	11
Negative	11	18

¹Cooksey test

²Revised test

TABLE III
 DISTRIBUTION OF THE DIFFICULTY INDICES BASED ON THE UPPER
 AND LOWER 27 PER CENT OF THE STUDENTS
 TAKING THE TWO TESTS

Difficulty Range	Frequency 1964 Test ¹	Frequency 1967 Test ²
80 - 100	1	2
75 - 79	2	4
70 - 74	5	6
65 - 69	7	6
60 - 64	17	15
55 - 59	11	10
50 - 54	18	13
45 - 49	18	20
40 - 44	11	20
35 - 39	14	17
30 - 34	15	14
25 - 29	2	11
20 - 24	2	7
15 - 19	1	4
10 - 14	1	0
5 - 9	0	1
0 - 4	0	0

¹Cooksey test
²Revised test

shown in Table IV. The analysis for four items is shown to illustrate the system that was established for efficiently appraising each item according to the results from the two times of administering the tests.

Each of the items shown in Table IV showed a discrimination index below 15 in the original test. Although it has been pointed out repeatedly in recent literature that this is not sufficient reason for elimination of an item, it was felt that these items should be examined for the possible presence of ambiguity, clues, and other technical defects.

The discrimination index of item 1 was raised from 11 in the original test to 19 in the revised test by changing the first two distracters which had attracted only one of the 64 testees in the original test. Exemplification of the process follows.

Item 1 in the Cooksey test was: Jane is troubled by acne. Her doctor suggested that she should: (1) eat more carrots. (2) change her brand of cosmetics. (3) eat liberal amounts of fruits and vegetables. (4) avoid chocolate entirely.

Consideration of the distracters revealed that distracter (1) is only one part of distracter (3) and thus did not attract any testees. Distracter (2) is not similar in content to the other three and is obviously incorrect on a nutrition test. Therefore the author was called upon to construct two distracters for the revised test eliminating these that had caused the question to be a true-false test by giving the testees the choice of only two distracters. The revised item 1 consisted of the same stem and distracters (3) and (4) remained the same. The two replacements were: (1) take large doses of vitamin A. (2) choose snacks only for energy. The data in Table IV show distracter (1) attracted 18 per cent of the high group and an equal number of the low group, whereas distracter (2) attracted none.

Item 41 in the Cooksey test had a discrimination index of four and in the revised test it was raised to 41 with the difficulty being raised whereas it was lowered for item 1. These items are under

TABLE IV

COMPARISON OF RESULTS OF ITEM ANALYSIS OF COOKSEY AND REVISED PRETEST

Item No.	Correct Answer	Test	Disc. Ind.	Diff. Ind.	27%	Proportions of Successes	Distracters			
							1	2	3	4
1	3	C ¹	11	46	High Low	0.50 0.33	1 0	0 0	20 16	11 16
		R ²	19	52	High Low	0.69 0.38	2 2	0 0	10 7	1 4
41	4	C	4	50	High Low	0.54 0.46	3 3	7 5	1 5	21 19
		R	41	41	High Low	0.59 0.08	0 1	2 1	2 7	9 4
60	2	C	8	37	High Low	0.33 0.21	7 11	16 3	2 8	7 10
		R	46	35	High Low	0.49 0.03	0 1	8 3	2 2	3 7
103	1	C	0	30	High Low	0.17 0.17	4 4	2 8	25 19	1 1
		R	19	46	High Low	0.59 0.28	9 6	1 1	0 1	3 5

¹Cooksey test²Revised test

different content aspects as well as behavioral aspects in the table of specifications, with item 1 being on nutritional status and in the affective domain. The question was taken from generalizations under objective one which stated that the students should develop some awareness of the importance of good health and of the contributions of nutritious food to growth and to positive health. Item 41 was constructed from generalizations for objective two which stated that the students should develop some understanding of basic nutrition knowledge including the life processes and the role of the nutrients in these processes.

Item 60 was improved to yield a discrimination index of 46 instead of eight in the original test. It was felt that it had been too specific requiring rote memorization of nutrients in foods in the original test and was improved to measure the understanding of a principle with ability to synthesize and generalize. The two questions are shown for comparison:

C 60. Which food would be particularly helpful to a person suffering from nutritional goiter? (1) Liver. (2) Oysters. (3) Lake Trout. (4) Lean Pork.

R 60. Normally iodine is needed to replace losses. Amounts are (1) the same in weight as iron. (2) small and variable. (3) varied according to amount of exposure to sun. (4) varied according to activity.

Objective five stating that students in a beginning nutrition class should develop an increasing interest in becoming an informed participant in social action pertaining to governmental laws and regulations related to food and nutrition, paralleling formation of judgments from correct interpretation of data. The generalizations for achieving this objective included statements from which the revised item was selected. The discrimination index was raised from

zero for the original test to 19 for the revised test by changing the distracters as follows:

- C 103. For which of the following is there a mandatory standard? (1) Butter (2) Eggs (3) Beef (4) Oranges
- R 103. The Food Additives Amendment to the Pure Food and Drug Law requires that (1) any new food additive must be tested for safety on animals. (2) specified amounts of vitamins be added. (3) specified amounts of calcium and iron be added. (4) all additives must improve keeping qualities of foods.

CHAPTER V

SUMMARY AND CONCLUSIONS

The problem in this study was the refinement of a pretest to be used in a beginning nutrition course. A one-hundred and twenty-five item multiple-choice instrument developed by Cooksey in 1964 was analyzed by the author. Those items lacking proper discriminability were revised or omitted and additional questions constructed to form a one-hundred and fifty item multiple-choice test. Item analysis was made of the revised test and the items having suitable discriminability were retained for the instrument to be used as a pretest in nutrition.

The first step in refining the pretest was the formulation of objectives for a beginning nutrition course as it is currently being taught. These objectives were analyzed by a behavioral-content chart to detect weaknesses in measurement of the different behaviors necessary for sound learning principles.

The generalizations formulated by Cooksey were revised by eliminating some and combining some; and by the addition of others to include current concepts in nutrition which are in agreement with recent research.

A computer program outline was developed for analysis of the items and scores of the test as given by Cooksey. Sufficient replications of the mathematical manipulations were performed as a means of checking the program so that this method may be used with confidence in future

analyses of items and test scores.

The data from these analyses were used in the elimination of some and the reworking of other items. The coefficient of reliability of Cooksey's test scores was 0.84. By the computerized method of calculating discrimination indices, 35 items or 28 per cent were below the acceptable standard and eight per cent failed to meet the acceptable levels of difficulty.

The 56 replacement questions were constructed to meet criteria for suitable multiple choice items, each with a stem and four distracters. These questions were chosen from subject matter areas identified as needing emphasis according to the table of specifications. The validity of the test was demonstrated by the comparison of the content shown in the table of specifications with that of current textbooks on nutrition.

The revised test was administered to 47 undergraduate men and women, scored, and analyzed. The coefficient of reliability of the test scores was 0.86. Thirty-three per cent of the test items were below the level of discriminability and 16 per cent of the items failed to meet acceptable levels of difficulty. Although there is evidence to support arguments that items below the level of 15 for discriminability may be acceptable test items, the exclusion of those doing so would leave 101 items or one more than is necessary for the test.

Conclusions

The hypothesis underlying this study was sustained. A pretest containing 100 multiple-choice questions meeting the acceptable level

of discriminability was devised. The content validity was checked on a table of specifications. The coefficient of reliability of test scores was raised from 0.84 for the original test to 0.86 for the revised test.

Recommendations

The author believes that the pretest should be administered to larger numbers of students. The analysis of the test showed that 101 of the 150 questions could be used to discriminate between the good and poor students. Before it is used for sectioning students, it should be given to students enrolled in beginning nutrition in the fall semester of 1967 at Oklahoma State University.

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A P P E N D I X

OBJECTIVES FOR BEGINNING NUTRITION COURSE

The students in a beginning nutrition class should develop:

1. Some awareness of the importance of good health and of the contributions of nutritious food to growth and to positive health which includes the mental, emotional, and physical well-being of an individual.
2. Some understanding of basic nutrition knowledge including the life processes and the role of the nutrients in these processes.
3. Application of principles in the solution of one's own nutrition problems striving always for a balanced diet and taking responsibility for self-direction.
4. Some consciousness of the importance of research in food and nutrition and of the scientific principles involved in preparation of food.
5. An increasing interest in becoming an informed participant in social action pertaining to governmental laws and regulations related to food and nutrition, paralleling formation of judgments from correct interpretation of data.
6. Some skill in recognizing assumptions and in evaluating mass media concerning food and nutrition in relation to its reliability.
7. An appreciation and understanding of different cultures in relation to their food habits and usage at local, national, and international levels.
8. Some awareness of the values related to the use of modern processed foods and their contributions to creative, healthful living.

GENERALIZATIONS FOR BEGINNING NUTRITION

Generalizations for Objective 1:

- I. Nutritional status may be checked continuously by keeping a record of body measurements, notably height and weight.
 - A. Height-weight-age tables are helpful in evaluating growth, but comparisons should also be made of a child's present state with his past over a period of time.
 1. Ideal reference tables are based on measurements of children known to be in good nutritional state and to represent the population under study in environment and nationality background.
 2. Children who are considerably below the average weight for their height and age may tire more easily and have less endurance than others, although these conditions may be hidden by drives which lead the child to excessive activity.
 3. One of the easily detectable signs of undernutrition is the failure of children to make expected weight gains; however, children who deviate markedly from the standards may be healthy if they are growing and have other characteristics of good health.
 4. During the adolescent period normal boys and girls of the same age may differ by four or five years in their physical development.
 5. Girls begin the adolescent spurt in growth about two years earlier than boys, but the growth spurt of boys, when it comes, is greater than that of girls.
 - B. Height-weight-age tables are useful guides for adults in maintaining desirable weight.
 1. The significance of deviations from standards should be interpreted in the light of the health and the body build of the individual.
 2. Generally, deviations from standards of plus or minus ten per cent suggest the need for nutritional readjustment.
- II. Nutrition can affect how you look by its influence on the different parts of your body and the characteristics which relate to your personal appearance.
 - A. Good nutrition plays an important part in producing an attractive skin.

1. The skin of a well-nourished person is usually smooth, slightly moist, and tinged with pink; that of a poorly nourished person is likely to be dull and lifeless.
 2. Inadequate amounts of vitamin A in the diet for long periods of time result in dry, scaly skin which is more susceptible to infection than normal skin.
 3. Insufficient amounts of riboflavin in the food supply may result in a greasy scaly dermatitis around the nose and cracks at the corners of the mouth.
 4. If diets low in iron and protein are consumed over a period of several weeks, the hemoglobin which requires iron for formation will not be plentiful enough and the skin of the individual may be pale in color.
 5. Although the acne of adolescence may be unrelated to nutrition, a good all-around diet together with cleanliness, may help to combat it.
- B. Whatever the causes of poor nutrition--whether poor diet, infection, or disease--nutritional deficiency during the formation of the teeth results in their imperfect development and predisposes them to decay.
1. If nutritional deficiency is present when the permanent teeth are being formed, the permanent teeth often suffer injury more than do the temporary ones.
 2. If the fluorine concentration in drinking water of children whose teeth are in the formative stage is over 2 parts per million, colored staining or mottling of enamel may occur; the incidence of dental decay is markedly reduced if fluoride is added to water to a concentration of 1 part per million.
- C. Because of the sensitivity of the eye to general body conditions, poor nutrition may affect adversely the efficiency of this organ; in fact, the eye is often a sensitive indicator of the state of nutrition.
1. Usually the eyes of the well-nourished, healthy person, with good habits of living, are bright and clear.
 2. After very long and severe shortages of vitamin A the covering of the eyeball and the mucous membrane around the eye may become dry and hard and sometimes even blindness may result.
 3. If there is severe lack of riboflavin, the blood vessels of the covering of the eyeball become enlarged or may burst, and the eye may be clouded by the thickened tissue or be blood-shot.

- D. Hair and nails are body tissues which reflect the state of nutrition.
1. When the food supply of protein, minerals, and vitamins is adequate hair tends to be soft and lustrous.
 2. Good protein food, reinforced with minerals, and vitamins efficiently used by the body, helps to form firm, well-shaped fingernails which can be groomed to attractiveness.
- E. Body size is a result of many factors such as diet, secretions of glands, inheritance, disease, and activity.
1. If the food intake exceeds the amount of food used by the body for exercise, maintenance, and growth there will be storages of the surplus and gain in body weight, due to the accumulation of body fat; conversely, if the food intake is less than the body needs there will be loss of weight.
 2. Fat deposits serve as a reserve supply of body fuel to be drawn upon in case of temporary shortage of, or increased need for fuel.
 3. Fat deposits under the skin help to soften the angles produced by the bones, and in proper amounts contribute to the attractiveness of the person.
 4. That characteristics of body build are inherited is evident in the similarity of bone structure that is often seen among members of a family.
 5. The fact that family members often have similar eating habits may account for the tendency toward fatness or thinness sometimes observed in families.
 6. Emotional disturbances such as sorrow, nervousness, irritability, anxiety, or lack of acceptance socially may increase or decrease the desire for food and thus affect body weight.
- F. Posture is in a large measure dependent on the tone of the muscles and the proper development of the bones, both of which are greatly influenced by nutrition.
1. When children including adolescents, receive too small a supply of protein, calcium, phosphorus and vitamin C and D, there is danger that the growth of bones will be stunted or that the bones will be improperly shaped.
 2. Malformation of the pelvis in childhood may cause difficult delivery for the mother at the time of childbirth and thus the nutrition of one generation affects

the welfare of the next.

3. With well formed bones, firm muscles, and normal pads of fat and connective tissue, the organs are held in their proper place and the disfiguring effect on posture of a protruding abdomen is avoided.
- ✓ III. Since endurance, vitality, and normal energy are qualities of high nutritional status, the lack of these are cause for improving the diet and may require the help of a doctor.
- A. When the vigorous life of an athlete increases his need for energy, it should be provided through an increase in health-protective foods as well as calories.
 - B. Poor nutrition makes people look dull, lifeless, and prematurely old.
- IV. Certain blood tests may reveal whether or not the intake of substances, as vitamin C and carotenoids, has been adequate.
- V. Other criteria for judging the nutrition of the individual are based on the study of body composition, functioning of the various parts of the body, and outward clinical manifestations which can be judged by the physician.

Generalizations for Objective 2:

- I. Digestion is the process by which food is prepared for absorption into the body proper.
 - A. The cells in their life processes use only simple substances called the end products of digestion.
 1. The process of digestion is chiefly concerned with breaking down into building stones: starch and complex sugars into monosaccharides; proteins into amino acids and fats into fatty acids and glycerol.
 2. The alimentary tract can be understood as organized for two sets of functions: its muscular or motor apparatus and its secretory apparatus.
 3. The food material progresses through the digestive organs by the physical steps of chewing, hunger contractions, and peristalsis.
 - B. The chemical processes in digestion take place through a cleavage of the complex food materials into their simplest component parts, with many intermediate compounds.
 1. These chemical cleavages constituting digestion are

brought about through enzymes, which are catalysts that are formed by living cells.

2. Enzymes are specific in that each one acts only on a certain type of substance, bringing about one special chemical reaction.
 3. The secretion of digestive fluids in the mouth and stomach is largely controlled by nervous impulses, but the flow of those in the lower part of the alimentary tract is due to the stimulation by chemical messengers carried in the blood and known as hormones.
- C. Factors which affect digestion act by either affecting the motor functions of the digestive organs, by exerting an influence on the flow of the digestive juices, or by altering the health of the digestive tract itself.
- II. Absorption is the process by which the products of digestion pass through the lining of the intestine into the blood and lymph.
- A. The absorption of food material takes place almost entirely in the small intestine.
 - B. Absorption is usually very efficient and complete; the food-stuffs (carbohydrates, fats, and proteins) are 90 to 98 per cent digested and absorbed on a mixed diet and under normal conditions.
 - C. In most instances, active transport processes enable absorption of a large amount of nutrient in a much shorter time than would be possible by simple diffusion.
- III. Metabolism is a general term used to designate all the chemical changes which occur in living matter in the course of its vital activities.
- A. Basal metabolism is a measure of the amount of energy required by the body to keep up the life processes. It represents the irreducible minimum of energy required and is affected primarily by body size, age, sex, and secretions of endocrine glands.
 1. The calorie--amount of heat required to raise the temperature of one kilogram of water one degree centigrade--is used to measure energy metabolism and requirements as well as fuel value of foods.
 2. Thyroxine, the iodine containing hormone secreted by the thyroid, has a very potent influence in speeding all the oxidative processes of the body.

B. Catabolism includes those processes by which either nutrients, reserve tissue material, or cellular substances are broken down with the liberation of energy.

- ✓ 1. The liver is the great regulator of blood sugar and the main storage house for excess carbohydrate in the body in the form of glycogen.
2. Muscles store small amounts of glycogen which can be readily drawn on for the energy needed for muscular work.
- ✓ 3. The ultimate fate of carbohydrate is to supply energy for body needs.
- ✓ 4. Excess carbohydrate intake, above the amount which can be converted into glycogen, is stored in the form of fat in the adipose tissues of the body.
5. Fat is a very concentrated form of body fuel with the excess being deposited in adipose tissue.

C. Anabolism includes all chemical changes by which the absorbed products of digestion are built into new tissues in growth or are used for replacements.

1. Amino acids may be recombined to make protein for building new tissue or for upkeep.
2. Amino acids may be combined in small amounts to build various hormones, enzymes, and antibodies.

IV. Excretion is the process by which the body rids itself of waste products by four pathways--namely, the lungs, the skin, the kidneys, and the intestine.

A. Dietary factors may alter the effectiveness of the kidneys in two important roles.

1. If normal osmotic pressure and the proper kinds and amounts of electrolytes in body tissues and fluids are maintained, the intake of sufficient water and foods with high moisture content is important.
2. When large amounts of fat are eaten or they are incompletely oxidized in the body, acidic intermediate products accumulate and the neutrality of the body is destroyed.

B. Excretion through the intestines may be affected by the nature of the diet or differences in nervous sensitiveness.

- ✓ 1. Fibrous vegetables, fruits, and unrefined cereals increase the bulk of intestinal food residues.

2. Adequate amounts of water drunk regularly throughout the day are important in avoiding constipation.
3. Regularity and proper exercise may be as essential to good elimination as food intake.

Generalizations for Objective 3:

- I. Under normal conditions individuals may obtain the needed nutrients except vitamin D, through natural foods.
 - ✓ A. Education and training in the wise selection of food for health are important, since human beings are not known to have inherent impulses or drives to select the food they need.
 1. Milk and some products derived from it provide the main source of calcium in the diets of the people of this country, and in addition are an excellent source of protein and riboflavin.
 - a) Two or three dips or about one and one-half cups of ice cream provide as much calcium as one cup of whole milk.
 - b) A scant one-fourth cup of nonfat dry milk solids is equivalent to one cup of skim milk.
 - c) One cup of fresh, whole milk is approximately equivalent in nutrients to one-half cup of undiluted evaporated milk or a one ounce cube of cheddar cheese.
 - d) Milk is valuable whether used in a beverage or in prepared foods such as creamed or scalloped vegetables and cream soups.
 - e) Such desserts as ice cream, custard, bread pudding, cornstarch pudding and custard, pumpkin, and cream pie contribute one-third to one-half cup of milk per serving to the diet, while cake and cookies contribute little or none.
 - f) For habitual use, plain pasteurized milk is preferable to flavored milk.
 2. A protein food from an animal source, such as milk, meat, cheese, in combination with cereal will ensure that all essential components are present simultaneously so that protein synthesis will ensue.
 3. The legumes are sometimes called "poor man's meat" because the protein of these foods are valuable when taken with animal protein.

4. Organ meats, such as liver and kidney are frequently cheaper than other parts of the animal and contain good quality protein.
 5. When eaten raw, many fruits contribute large amounts of vitamin C to the diet. Fruits as a food group also contribute bulk to the diet.
- B. Since vitamin D supplements are very potent and because excess can be harmful, they should be given in doses exactly as directed.
1. Fish-liver oils or concentrates of vitamin D are given to children to supply vitamin D, since foods in their natural state contain it in negligible amounts.
 2. When clothing, smoke, fog, window glass, or geographic location prevents direct rays of the sun from reaching the skin, vitamin D should be supplied to growing children and pregnant and lactating women through supplements such as cod-liver oil and vitamin D concentrates or through vitamin D enriched milk.
 3. One quart of vitamin D milk usually contains the Recommended Dietary Allowances of vitamin D for children of all ages and for pregnant and lactating women.
- C. With the proper selection of natural foods it is unnecessary for normal healthy adults to take vitamin pills.
- ✓ 1. Fruits, fruit juices, tomato or vegetable juice, and raw vegetables are good ways to increase the vitamin and mineral content of the diet.
 2. Edible organ meats such as heart, kidney, and liver are valued for their protein, mineral and vitamin contribution to the diet.
 3. It is possible for an individual to eat four ounces of stew meat and obtain the same nutritive value as he would from four ounces of porterhouse steak.
 - ✓ 4. When skim milk is substituted for whole milk in order to reduce the calorie intake, it should be liberally supplemented with foods of high vitamin A value, as green and yellow vegetables, eggs and liver.
 5. Mineral oil dissolves the carotene of green and yellow vegetables and fruits, and if used along with these foods may interfere with the absorption of this substance and reduce its value as a source of vitamin A to the body.

- II. Some knowledge of the nutritive value of foods is important in making dietary adjustments for changing conditions of life.
- A. The nutritional needs of children differ from those of adults in three main ways:
1. Their energy requirement per unit of weight is higher than that of adults.
 2. Their food should contain a higher proportion of tissue-building materials (proteins and mineral elements) and of vitamins than that of adults.
 3. Their diet should be made up of foods that are suitable to the digestive abilities of any given age.
- B. The basis of every child's diet should consist of milk, suitable cereals and bread, fruits and vegetables, meats, eggs, and simple, nutritious desserts and soups.
1. When the growth rate increases, the quantity of recommended foods can increase.
 2. As the digestive tract becomes equal to handling foods in rougher forms and larger particles, the form may be changed.
 3. If new flavors and varieties of food are offered with familiar, well-liked foods, good diet habits are encouraged.
- C. Adolescence is the period of greatest physical, biological, and emotional activity.
1. The needs for energy and other nutrients increase sharply at this age.
 2. In a specific age group, growing boys usually need more food than girls due to their greater activity, muscle mass, and usually larger size.
 3. Because of increased losses of iron from the body, nutritional anemia may occur in young girls whose diets are on the borderline of adequacy for iron.
- D. The extra allowances of all the essential nutrients recommended for pregnancy by the National Research Council are a protection for both mother and child.
1. If the mother's diet is rich in iron, the child will be born with a liver well stored with iron for the months when it will be fed chiefly milk--a food of low iron content.

2. Milk is the most indispensable food in the basic diet of pregnancy to ensure teeth of good quality and well calcified bones in the child.
 3. During lactation, there is a very high need for energy, protein, minerals and vitamins.
- E. Nutritional needs of the older person vary slightly from those of the younger adult.
1. In the later years of life the ability of the body to handle an excess of food is diminished and caloric needs are reduced.
 2. Current studies indicate that the protein requirement in old age is no lower than in earlier adult life.

Generalizations for Objective 4:

- I. Research points to the important conclusion that the kind and amount of food eaten by people has an influence on their well-being.
 - A. A diet that meets the needs at one time may be insufficient under different physiological conditions.
 1. The National Research Council of the Food and Nutrition Board revises the recommended dietary allowances each five years.
 2. The allowances stated by the NRC are designed for maintenance of good nutrition of practically all healthy persons in the U.S.A.
 3. The RDA levels are intended to cover individual variations among most normally active people in a temperate climate.
 - B. Nutrition surveys indicate that the nutritional quality of food supplies of families may be associated more closely with other social and economic factors.
 1. The derivation of representative food composition values brings to light interesting similarities and differences among foods in the various food groups.
 2. There are many combinations of food or patterns of eating by which people may obtain a good diet.
- II. The advances of technology are important especially as they relate to the production, processing, and distribution of food.
 - A. Those who produce, process, and distribute food need data on the effects of diet on the health of people and the effects

of their health or well-being, or lack of it, in their use of food.

- B. Information on the kinds, qualities, and costs of foods consumed by different groups in the population is needed for educational and marketing programs.

III. Good nutrition is promoted by handling and using foods so that they will furnish their maximum of the nutrients.

- A. Appearance, quality, and nutritive value of vegetables and fruits are conserved by quick cooking in small quantities of water.

1. The liquid in which vegetables are cooked contains valuable minerals and vitamins, and if not served with the foods, may be used in soups, sauces, and gravies.
2. If fruits and vegetables are kept at room temperature during slicing or chopping, they may rapidly lose vitamins through exposure to oxygen in air and to light.
3. Keeping vegetables hot after they are cooked or preheating cooked vegetables causes loss of some color, flavor, and vitamins.
4. Nutrients such as vitamin C., which are soluble in water and changed by exposure to air, are easily lost or destroyed in food preparation.

- B. Since vitamins are present in foods in very small amounts, they may be lost in processing and preparing for eating unless correct methods are used.

1. Many vitamins dissolve in water and can be destroyed when exposed to light and oxygen, or when heated, especially in the presence of an alkali such as baking soda; these facts should be considered in order to conserve vitamins during food preparation.
2. In cooking foods, the addition of an alkali such as baking soda, increases the losses of some of the vitamins, especially vitamin C and thiamine.
3. Addition of soda may preserve color of green vegetables but may cause some loss of vitamin C, thiamine, and to a lesser degree, riboflavin.
4. Since people eat foods that taste good to them, it is important that foods be prepared so as to be palatable as well as nutritious.

5. Fruits and vegetables, such as apples and potatoes, lose much of their vitamin C content when sieved or mashed, as contact with the oxygen of the air decreases their vitamin C content.
- C. Since the nutrients in foods are not usually distributed equally in all parts of the food, discarding portions of food may reduce its nutritive value.
1. Large amounts of the minerals and vitamins in vegetables often lie directly under the skin, so that vegetables cooked in the skin usually retain more food value than those cooked by other methods.
 - a) The diets of the people of the United States were improved notably by enrichment of bread and flour.
 2. By discarding the outer green leaves of a head of lettuce, this food loses much of its value as a source of vitamin A and iron.
 3. Amino acids and fat may be lost if drippings from meat are discarded.
 4. Riboflavin, which is liberally supplied by milk, is destroyed when milk is exposed to direct sunlight.
 5. Storage in a dark place or opaque containers helps to retain the nutritive value of many foods.
 6. Since the juice of acid fruits may be less nutritious and desirable as a food than the whole fruit, it is probably unwise to replace whole fruit entirely by juices.
- D. Food must be made safe for human consumption even though the nutritive value may be slightly impaired.
1. Pasteurization makes fresh milk safe for human consumption but does not improve its nutritive value or remove the necessity for sanitary practices in later handling.
 2. The extent of the destruction of ascorbic acid in milk is dependent upon the exact method employed in pasteurizing.
 3. The use of pasteurized milk supplemented by foods rich in vitamin C is believed preferable to the use of raw milk because of the decreased danger of bacterial contamination.
 4. It is recommended that before milk be classed as "safe milk" it must have been both "properly produced and properly pasteurized".

- E. The importance of nutritive loss in food depends partly on how extensive it is and partly on the value of the food as a source of the nutrient in question.
1. Ascorbic acid is lost more easily from most foods than are other important nutrients.
 2. Foods lose some nutritive value during the canning process and afterward throughout the storage period.
 3. The development of newer techniques have succeeded in reducing losses of nutrients in canning and improving the quality of canned foods.
 4. Expulsion of air before sealing and processing foods reduces oxidative losses of vitamins at high temperatures.
 5. Canned meats lose some of their thiamine during storage. Riboflavin, another vitamin of which meat is a good source, is not affected by ordinary storage temperatures.
 6. Freezing, a relatively new way to preserve food, offers much in the way of retaining nutrients and eating qualities of foods.
 7. Storing many foods at a low temperature and a low content of moisture protects against loss of ascorbic acid and retards the browning reaction.
 8. Exclusion of air guards carotene as it aids in preventing rancidity.
 9. The bran layers and much of the germ of the cereal grain are removed in the milling of white flour.

Generalizations for Objective 5:

- I. A sanitary food supply requires proper legislation and public opinion.
 - A. The protection afforded the consumer by governmental agencies does not relieve the individuals of their responsibility in attempting to discern between fact and fiction.
 1. We are fortunate in this country to enjoy certain assurances by law that our food supply is wholesome.
 2. We may feel confident when making a purchase that the product conforms to the label description.
 3. Some of our protection is through federal laws, some by state laws and some through local regulations.

4. Foods bearing labels that are false or misleading are prohibited in shipment from one state to another.
 5. The federal law imposes certain specific requirements for the labels of foods intended for special dietary uses in order to inform the purchaser of the value of the food for such uses.
 6. The federal law makes a special requirement that foods for use in diets for the dietary management of disease or the control of body weight carry label statements of the percentage by weight of the protein, fat and available carbohydrate content and of the caloric value of a specified quantity of the food.
 7. The regulations of state laws vary from state to state. Most of them cover mislabeling of products and provide for certain sanitary regulations of products manufactured and put on the market within the state.
 8. Local laws apply for the most part to control of the quality and sanitation of milk products on the market and to the sanitary conditions of local eating establishments.
- B. The enforced enrichment of processed foods, when in the interest of public health, requires action at the state and national level.
1. When the average American's diet was found to be inadequate during the period of World War II, enrichment of several commonly used foods began.
 2. The food industries that produce and distribute foods, as well as homemakers and regulatory agencies, have responsibilities for the sanitary condition of foods.
 3. Processing converts perishable raw material to a stable form, of which very little is lost before it reaches the consumer.
- II. For some factors which influence nutrition, the responsibility of the individual must be exercised through participation in community, state and national affairs.
- A. Maintaining a sound economy with a high rate of employment and reasonable prices on basic food commodities is important to good nutrition.
1. Conditions which facilitate distribution from point of production to point of need are essential for good nutrition.

2. The authenticity of claims made and beliefs followed can be ascertained only by seeking reliable sources of information based on research findings.
- B. Because more than half the world's population goes hungry, efforts are being made to produce more nutritious food for those areas.
1. Agencies around the world are directing projects to improve the quality and quantity of food supplies.
 2. Since all the common cereals are deficient in lysine and the small content of methionine limits the efficiency of the legumes, the addition of lysine to cereals and methionine to pulses in amounts of the order of one-half of one per cent greatly increases the efficiency of the proteins that these foods contain and renders them much more nearly equivalent to animal proteins.

Generalizations for Objective 6:

- I. Good nutrition demands that one be able to discriminate between fact and fallacy in the vast amount of advertising and popular beliefs about the use of foods.
 - A. Sound information about the nutritive value of foods and the nutritional needs of the body provides the best basis for making intelligent choices of foods in spite of the mass of information and misinformation confronting the consumer.
 1. There is no reason to believe that any combination of sanitary foods is harmful or poisonous, or that certain foods when used together have some unusual reaction on the body.
 2. There is no food that has any effect on sexual potency.
 3. No foods or diets are known which can cure patients who have arthritis, rheumatism, or cancer.
 4. Money spent for "health foods" and "health aids" will usually be better spent for nutritious foods which contribute toward a good diet.
 5. Foods lose their identity in the digestive tract and, although they provide many nutrients needed by any part of the body, they do not serve a special purpose, as for example, fish serving as a brain food.
 6. Special diets, advertised to meet specific conditions, very often are seriously harmful if used over a period of time.

7. Medical attention to a serious ailment may be delayed while a food quack or faddist attempts to treat the condition.
 8. Acid fruits and vegetables do not produce an acid condition of the body.
- B. Food misinformation encourages the waste of money and it threatens health through misinterpretation of facts, defeating acceptance of scientifically-sound nutrition.
1. Protection of food by industry and by law is excellent, and the foods available at your local grocery store are not only attractive and flavorsome but are also completely adequate to supply all of your nutritional needs.
 2. When unknowing or unscrupulous promoters distort the facts and claim benefits against diseases or symptoms which are not caused by a dietary deficiency at all--the results can be tragic.

Generalizations for Objective 7:

- I. Food habits often reflect the family's customs, nationality, and religious background.
 - A. Children learn the traditional food habits of their families and these habits in turn are passed on to their children.
- II. Foods vary considerably in caloric value and many which are high in calories actually have empty calories since they do not carry their quota of vitamins, proteins, and minerals.
 - A. Snacks comprise an appreciable percentage of the day's food intake for many people, and should contain nutrients other than calories.
 1. It may be advantageous to ingest food at frequent intervals throughout the waking period of the day.
 2. In the use of snacks for obtaining added nutrients, it is important to learn the variety of food groups and to know which foods are interchangeable.
 - B. A wise consumer considers the Basic Four when planning snacks in with the regular meals.
 1. What is eaten between meals should not interfere with regular meals.
 2. Snacks of fruit, milk, crackers with nutritious spreads or cheese, and meat sandwiches are among the recommended ones.

Generalizations for Objective 8:

- I. The wide variety of foods available to the American housewife is due largely to the methods of processing and preservation developed by scientists in universities and industries.
 - A. Dehydration now includes new methods of quick-drying at lower temperatures under vacuum or reduced pressure.
 1. Liquid products may be blown in small droplets into a heated chamber where they dry almost instantly to a fine powder.
 2. This is the best form in which to ship nutrients to foreign countries to provide animal protein and calcium.
 3. Freeze-drying is a process whereby raw food is quickly frozen and moisture removed by sublimation.
 - B. Irradiation and addition of antibiotics to food for preservation are still in the experimental stages.
 - C. Frozen foods are strong competitors with fresh varieties of foods, often being as nutritious and economical as the fresh.
- II. The advantages of by-passing some tedious processes in the preparation and cooking of foods are evident; but there are some precautions to be considered.
 - A. Foods that involve the most expense for labor, packaging, and refrigeration are expensive.
 - B. There is still need for meal planning to make sure that the family receives the recommended number of servings of the four food groups to ensure an adequate intake of all nutrients each day.
 1. The meat, fresh vegetables, and fresh fruits may be skimpy in the ready assembled meals.
 2. If used often, hastily assembled meals become monotonous, resulting in loss of appetite.
 3. For feeding young children, the homemaker cannot depend on mass-produced foods or meal combinations put together by commercial firms.

BEHAVIORAL-CONTENT CHART OF OBJECTIVES

Content Aspect of the Objectives	Behavioral Aspects of the Objectives					
	Cognitive Domain			Affective Domain		
	Knowledge	Comprehension	Application	Attending and Responding	Valuing	Organizing
1. Measures of nutritional status	X		X	X	X	
2. Life processes and role of nutrients	X	X		X		
3. Requirements for stages of life and food sources	X	X	X			X
4. Research in nutrition and principles of cookery	X	X				X
5. Food additives and sanitation laws				X	X	X
6. Fads, fallacies, and advertising				X	X	X
7. Social and cultural aspects of food-- world problems	X			X	X	
8. Convenience foods enrichment and fortification		X	X		X	

TABLE OF SPECIFICATIONS

Subject Matter Topic	CONTENT		BEHAVIORAL CHANGES IN:	
			Cognitive Domain	Affective Domain
	Questions No.	%	No.	No.
1. Nutritional Status		4		
Appearance	4		1	3
Endurance	3		2	1
2. Life Processes		10		
Digestion	5		3	2
Elimination	2		1	1
Metabolism	7		5	2
Role of Nutrients		33		
Carbohydrate	5		3	2
Fat	5		4	1
Protein	13		6	7
Vitamins	15		6	9
Minerals	9		5	4
Water and Cellulose	3		2	1
3. Requirements for Stages of Life		9		
Children	3			3
Teenagers	1			1
Athletes	5			5
Pregnancy & Lactation	2			2
Adults	3		1	2
Food Sources	12	8	7	5
4. Research	9	6	5	4
Principles of Cookery	8	5	3	5
5. Food Additives and Legislation	10	7	4	6
6. Fads and Fallacies	9	6	2	7
7. Food Habits and Cultural Influence	9	6	3	6
8. Convenience Foods Enrichment	8	5	3	5

Total in cognitive domain 66 or 44%.

Total in affective domain 84 or 56%.

VITA

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