AN ABSTRACT OF THE DISSERTATION OF

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in Education presented on November 27, 1979

Title: The Development of an Instrument to Assess Oregon High School Students' Nutrition Knowledge

Approved: Redacted for Privacy

The purpose of this investigation was to develop a valid and reliable instrument to assess Oregon high school students' nutrition information.

The following steps were taken in order to achieve this purpose.

First, a review of the literature pertaining to high school nutrition curriculum was conducted.

Second, numerous published tests designed to assess high school students' nutrition information were examined.

Third, principles of test construction were identified.

Fourth, objectives were selected to serve as a guide for item development.

Fifth, a pool of 75 items was constructed and used for the preliminary test.

Sixth, the test directions and several items were

revised to serve as the first trial instrument. Five low-scoring items were omitted.

Seventh, the 70-item, five-option test was administered to 300 students in three Oregon counties. The data were analyzed and several items were revised.

Eighth, a panel of 13 experts in the fields of test construction, health education and nutrition evaluated the items for scientific accuracy, clarity, importance and appropriateness for high school students. From their recommendations the test was revised down to 50 items.

Ninth, the second trial instrument was administered to 4,518 students from 60 randomly selected Oregon high schools. The resulting data were converted into norms.

Before any meaningful generalizations can be made, the instrument providing the data must demonstrate a high degree of validity and reliability. An item analysis of the second trial administration revealed the 50 items to be within the accepted range of difficulty. The items discriminated positively, and all but two distractors were plausible enough to be selected by at least two percent of the student respondents. Statistical analysis revealed the instrument to be valid. The reliability was calculated by the odd-even number split-halves method and adjusted by the Spearman-Brown Prophecy Formula. The reliability coefficient was .899, which, according to standard testing criteria, is considered high.

The second trial test was administered during the 1979 spring school term. One point was awarded for a correct answer and no points were deducted for an incorrect answer. Out of a possible 50 points, the mean score for the entire population was 27.667, with a standard deviation of 9.33.

An analysis of variance test was performed on the variables of age, sex, grade and size of school. There was a significant difference in mean scores between age groups, in that scores consistently increased with age. Females scored 16 percent better than males. Grades 9 through 12 were represented in the study. There was a significant difference between each grade level, always in favor of the upper grade. To insure a representative sample, the Oregon School Activities Association standard for size of school was used. A significant difference in mean scores was demonstrated, with the AAA schools scoring higher than the AA and A schools. There was also a significant difference between the mean scores of urban and rural students, with the urban students scoring higher.

It was concluded that:

1. There was a need for an instrument to assess student achievement of selected nutrition objectives.

2. The instructional objectives of the School Health Education Study were useful as a source for the construction of the instrument.

3. A valid and reliable instrument able to evaluate

student achievement of selected nutrition objectives was constructed.

The Development of an Instrument to Assess Oregon High School Students' Nutrition Knowledge

by

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A DISSERTATION

Submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Education

Completed November 1979

Commencement June 1980

APPROVED:

Redacted for Privacy

Professor of Health
in charge of major

Redacted for Privacy

Dean, School of Education

Redacted for Privacy

Dean of Graduate School

Date thesis is presented November 27, 1979

Typed by Karen Bland for Glenn Darrell Passwater

ACKNOWLEDGEMENTS

It is a treasured moment when I can express my appreciation to everyone who contributed to my doctoral thesis.

I wish to thank Dr. David Phelps, my major professor, for his leadership, trust and support. I am also thankful to Dr. Roy Foster, Dr. Marjorie McBride, Dr. Michael Colbert and Dr. Frank Dost for serving as committee members throughout my graduate program. Their cheerful assistance and learned suggestions were appreciated.

I am grateful to Dr. Verne Duncan, Mr. Len Tritsch and Mrs. Gloria Currier of the Oregon Department of Education for their program assistance and financial support.

I acknowledge Ms. Jean Peters and Ms. Georgene Barte of the Oregon State University Department of Foods and Nutrition for their valuable nutrition information and guidance during the construction stages of the instrument.

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I. INTRODUCTION

We shop, prepare, eat, clean up after and often spend time waiting for food, yet we seem to be misinformed about its significance and influences on our bodies. Food serves more than a purely physiological function in today's culture. It is a common denominator for social gatherings and can be associated with our daily emotional status.

Medical researchers have studied the effect food has in prenatal, infant and adolescent development (38:183). Yet, even with these published facts, research reveals that many pregnant teenagers are today not eating the recommended nutrients for healthy baby development (34: 119).

Attention has been focused recently on the extent to which malnutrition in early life influences behavior and learning abilities (33). Read stated that nutritional deprivation can cause physical and mental underdevelopment. Malnourished young people exhibit behavior commonly characterized by apathy and/or irritability (63:379).

At the other extreme of poor nutritional practices is the problem of obesity. Winick's survey indicates that nearly ten percent of the teenagers in the United States

are obese (79:81). Mayer points out that about one-fifth of all American adults are either obese or borderline obese. Many people are unaware of the problems associated with obesity and may also have little knowledge in balanced nutritional standards (55:8). Kirk, Hamrick and McAfee surveyed 3,000 high school students in 1975 and discovered that daily nutrient intake of 14- to 17-year-old students was well below the recommended daily amounts. They concluded that there was a need for nutrition education in the schools. The research also pointed out that the students scored ten points less than the national high school student norms on a health behavior inventory (50:68).

Mayer holds the schools responsible for contributing to nutritional misinformation. He states, "We have been telling people what they should eat, but avoiding strong statements about what they ought not to eat or eat less of." He also recommends an attack on ignorance about the controversial areas of nutrition, such as the world food situation, the price structure of the food industry and food additives (55:8).

Schwartz found that female high school graduates were nutritionally misinformed and their practices in nutrition were unsound. It appears that the schools did not furnish these girls with adequate amounts of nutritional information to carry them through an adulthood of balanced eating (66:28).

According to Mahoney, the average person goes on, and off, 1.4 diets per year. People are aware of their overweight conditions but do not seem able to find the key to keeping their weight within limits. Fad diets are more prevalent today than ever before in our American culture. Pharmacy shelves are stocked with diet pills and pamphlets on the latest diets. Some of these diets may be hazardous. Recently, for example, a number of people died from using a fad liquid-diet substance that many of them believed to be "well-balanced" (53:39).

Several studies have been conducted to identify nutrition problems in school-age young people. In 1969 the Connecticut Board of Education conducted a survey of 5,000 students from kindergarten through grade twelve and asked the students what they believed their health needs were. Byler reports that students in each of the grades felt a need for sound nutritional information (3:106).

The School Health Education Study (23), a nationwide study conducted in the mid-sixties under the direction of Sliepcevich, identified ten health concepts and developed curriculum to meet the needs of each student. One concept dealt with nutrition: "Food Selection and Eating Patterns Are Determined by Physical, Social, Mental, Economic, and Cultural Factors." They have assessed an important need in the school systems (105).

In the State of Oregon's "Goal-Based Planning," most

districts have listed "sound nutritional practices" as a competency that all students must attain during their high school years (103:15).

Statement of the Problem

The purpose of this investigation was to construct a valid and reliable instrument of selected nutritional objectives. This instrument was designed for use by those in administrative positions to assist them in deciding if a nutrition education program is needed for their community. This decision would be based upon empirical evidence rather than emotional reactions to the subject.

Design of the Study

To fulfill the intended purpose of this investigation, the test construction and descriptive survey methods were used. The following steps were taken in order to achieve this purpose.

1. A review of the literature pertaining to a) high school nutrition curriculum and b) test construction was conducted.

2. Objectives were selected from the School Health Education Study, concept ten, levels three and four.

3. A content outline was followed.

4. A pool of 70 items served as the first trial instrument.

5. The first trial instrument was administered to three high school classes. The resulting data were statistically analyzed to determine validity and reliability.

6. The revised test was submitted to a panel of nutrition and test-construction experts to help determine validity. Written correspondence was used to secure the data.

7. The second trial instrument was administered to 4,518 high school students. The schools were randomly selected from throughout the state of Oregon. See Appendix F for participating schools.

8. The resulting data were converted into norms.

Scope and Delimitations

Scope:

This study was designed to construct a valid and reliable instrument consisting of 50 multiple-choice questions for assessing high school pupils' achievement of selected nutrition education objectives.

Delimitations:

Only nutrition objectives in the cognitive domain were considered. No other area of health education was considered in the test. No attempt was made to determine the effectiveness of present teaching methodologies in nutrition. This test was designed to assess student knowledge

on the basis of the information nutrition experts believe to be necessary for nutritional literacy.

Assumptions

In conducting the investigation, certain assumptions were made.

1. Nutrition education is a vital function of the health education curriculum as determined by authorities in the fields of education and health education.

2. The needs and interests of high school students can be determined by assessing or analyzing learners, the society in which they live and the body of knowledge.

3. Appropriateness of nutritional content can be established by securing opinions of recognized experts in the field of nutrition.

4. Experts in the field of nutrition and authors of current instructional materials and textbooks may hold different opinions.

5. Evaluation of student achievement of selected nutrition objectives is significant for sound curriculum decisions.

6. A valid and reliable instrument can determine students' knowledge.

7. A recognized need exists for research for the improvement of evaluation instruments.

8. A valid and reliable instrument, assessing

students' knowledge of selected nutrition objectives, could be constructed.

Importance of the Study

Research indicates that nutritional care in this country is improving. Young people today tend to be heavier and taller than were their parents. They are becoming physically mature six months to two years earlier than their parents or grandparents (20:28). Oberteuffer, Harrelson and Pollock write,

> Modern food preservation techniques have eliminated seasonal nutritional deficiencies that once had to be endured. More is known about the function of nutrients in supporting essential body needs. In the richer countries, particularly, meat is easily obtained, and other good sources of protein are abundant. A wide variety of vitamin-rich foods and plenty of milk and other dairy products are prepared and marketed under controlled standards of quality (20:28).

School food service programs, such as the School Breakfast and Lunch Programs established under the 1966 Child Nutrition Act, have been implemented and continue to expand. Their goal, to eliminate hunger and undernutrition, significantly contributes to the nutritional needs of many young people.

But providing financial aid for food has not and will not by itself remedy the causes of nutritional deficiencies. Kime, et al., writes, "It is distressing to find people with nutritional problems in a country as affluent

as the United States" (14:37). Serious nutritional problems are evidenced at all economic levels of our society and are partly attributable to poor habits, lack of knowledge and insufficient finances (65:9)(14:37).

In the midst of national improvement in nutritional care, the problem of nutritional balance is still considerable. Results of the Ten-State Nutrition Study, conducted from 1968 to 1970 by the U.S. Department of Health, Education and Welfare, indicated that many of the people surveyed were chronically undernourished or had a severe risk of developing health problems due to nutritional deficiencies. Nutrient deficiencies are especially prevalent in economically depressed groups (41:1481). In a teenage nutrition status study, Hueneman found nutrient intakes declined with socio-economic status (48:17).

The impact of these dietary deficiencies relating to the basic health of the human body is substantial. Ullrich writes in an editorial that six of the ten leading causes of death in this country are partially attributed to dietary problems. These problems include diabetes, heart disease, strokes, hypertension, cirrhosis of the liver and arteriosclerosis (76:148). In 1976, the Senate Select Committee on Nutrition and Human Needs concurred with the inescapable relationship of diet to disease.

One of the most important nutrition-related diseases

is tooth decay. This is due, in part, to the large proportion of young people who receive inadequate amounts of vitamins to insure their dental health. Oberteuffer, Harrelson and Pollock state,

> In order to build strong tooth enamel the body must have calcium, protein, and vitamin D, plus trace elements of other minerals such as fluoride. If any one is missing, tooth development is hindered. Vitamin C is absolutely essential for strong gums, and more teeth are lost because of periodontal disease than from caries (20:30).

Researchers in Tennessee concur, reporting 14- to 17-year-old students had a below standard nutrient intake, and anthropometry and clinical examinations confirmed their findings of dental health problems (50:68).

The Ten State Nutrition Survey revealed that substantial numbers of young people have iron intakes below dietary requirements. A prevalence of iron deficiency was, in fact, found throughout the entire population studied (91: 12). These findings are important to educators in that the data suggests that iron deficiency anemia is associated with a decrease in attentiveness, persistence and purposeful activity, with an increase in irritability (63:379).

Leverton writes concerning the relationship between nutritional deficiencies and learning:

> Evidence is fast accumulating that nutrition can influence intellectual performance and learning. Nutrition can influence both the structure and the functioning of the brain and other structures of the complex central nervous system (51:7).

Therefore, the learning process is probably affected by low iron intakes. The findings of another study report alarming incidences of marginal iron status from 20 to 76 percent may be found among select groups of children in this country (43:328).

Poor dietary practices and food habits, imprinted during infancy and childhood, become increasingly pronounced during the teenage years. While it is estimated that up to one-fourth of school-age young people do not eat breakfast, the ratio increases significantly in the teen years. Nearly 41 percent of the students from a secondary school in New York was found on a surveyed day to have skipped breakfast (39:218). Another study showed that the meal most often skipped by California teenagers was lunch. Irregular eating habits were common to one-third of those students studied (48:17). There is a detrimental impact of meal skipping on nutrient intake. There is a tendency for students who have less than three meals a day to have poorer diets than more frequent eaters (45:385).

Diets of teenagers are known to be frequently inadequate in several nutrients. The Ten State Nutrition Study stated that teenagers had more problems in nutrition than all the age groups studied. A large percentage of teenagers was found to consume too little calcium, iron, and Vitamin A (91:15). Duffy reports that over ten percent of the teenagers in this country have iron deficiency

anemia (41:1481). Recent studies add ascorbic acid and Vitamin D to the low intake list (64:415)(20:29).

Most studies indicate the teenage girl often has the poorest eating habits of her family (86:5). Inadequate breakfasting, low caloric intakes and active life styles often result in poor health statistics. If pregnancy is compounded with these dietary practices, the results can be damaging, since one-fourth of the babies in this country are born to teenage mothers. Pre-pregnancy nutritional status and the teenager's diet during pregnancy both affect the outcome of the pregnancy (49:639).

In contrast to these reports of low intakes, some of the most common teenage nutritional problems are due to excess and/or imbalance of nutrients. An available and ample variety of food supplies does not insure nutritional balance. Oberteuffer, Harrelson and Pollock write that there is a pattern of "overdependence on carbohydrates in the form of sweet foods, french fries, and cola drinks" (20:29). Though during the mid-teens the growth rate substantially slows, adolescent eating behaviors and appetites often remain. This pattern of consumption can lead to a condition of obesity or overweight due to excessive body fat. An Oregon study of 15- and 16-year-olds found that 29 percent of the boys and 39 percent of the girls observed were overweight (86:5). Obesity, the most widespread form of malnutrition in this country, is associated

with many health problems. Its effect on self-worth is often devastating. A nutritional booklet, prepared by the State of Florida Department of Citrus, reports,

> Besides the well-documented association between obesity and disease, the emotional and psychological cost of being excessively fat is often substantial. The psychological problems are especially significant in societies such as the U.S. where body slimness is idolized (92:9).

The difficulty in working with the problems of malnourishment, inadequate vitamin and nutrient intakes, irregular eating habits and conditions of excess body fat rests in the fact that these are not caused by one single agent. Concerning this point, Briggs writes,

> Poor nutrition and malnutrition have many causes, including lack of motivation, poverty, disease, ignorance, false fears and efforts of unscrupulous purveyors of false information about food (36:52).

The commercial food industry in this country is big business. It is not easy to promote variety in food selection when the industry greatly influences food selection by promoting through advertising claims that a limited number of food items or vitamins can meet most of our nutritional needs (44:57). Unsuspecting consumers have believed claims that Vitamin E, lecithin, vinegar and honey, or bran are cure-alls for nutritional deficiencies. Guthrie states,

> It is difficult to offer a sound nutritional

> alternative to combat the conflicting and often highly emotional claims that immediate benefits can be achieved through the use of specific foods or food patterns (44:57).

Misleading information is a roadblock for educating the public. Nutrition books are in abundant supplies at local health food and book stores. In answer to public demand, libraries are stocking shelves with current diet and nutrition books. Unfortunately, much of the information which reaches the general public is automatically assumed to be accurate. The Oregon Nutrition Council comments

> Books are coming off the press at a rapid rate. Some are reliable, but many are not. Our democratic principle, freedom of the press, means that misinformation can be circulated and sold as freely as information that is accurate (86:9).

In many cases people make poor food choices and spend money unwisely to pay for food (91:3). Todhunter writes about the difficulties the shopper faces at the market:

> Today food technology, industrial development, and rapid transportation continue to greatly increase the number, kinds, and availability of prepared foods; fresh, canned, frozen, heat and serve, mixes and instant foods all in packages of every size, shape, and weight. Thus the shopper has a difficult problem in properly selecting the best buys in both nutritional and monetary value (74:9).

The recommendations from President Nixon's White House Conference on Food, Nutrition, and Health include this statement:

> The buying habits of the food purchaser,

> whether rich or poor, are not always based on adequate knowledge of the nutritional value of specific food products (20:29).

Teenage food selection is influenced by a variety of factors. The desire to achieve or maintain a certain ideal figure, to correct skin disorders or to conform to accepted social behaviors all play a role in establishing their eating patterns. Oberteuffer, Harrelson and Pollock state, "A teenager is far more interested in learning what foods will help him become what he wants to be than in memorizing the four food groups or in hearing that certain foods are 'good for you' "(20:29). Studies show that employment, the degree of social interaction, the parents' occupation level and mother's educational background are factors influencing young peoples' food consumption practices (64:415).

Concerning the eating habits of teenagers, Kirk, Hamrick and McAfee reported that teenagers feel mothers should be responsible for providing them with nutritional food, but they admit that their food selection is influenced by their peers. It is evident, then, teenagers do not personalize the importance of nutrition and are not motivated toward nutritional literacy. Results of a high school student questionnaire showed that, compared to other health areas, nutrition was of relatively low interest to them (50:69).

It has been hoped that nutrition education could solve many of the dietary problems facing teenagers today. The

Nutrition Education in Elementary and Secondary Schools Panel reported that sound nutrition education should help teenagers make wise food choices throughout their lives (52:18). Most frequently, nutrition has been included in the school health education curriculum. The goal of health education, to help individuals avoid the accidents and diseases of life and fully realize social and physical potentials, can be partially realized through nutrition instruction.

Unfortunately, high school students' low interest levels have hampered the fulfillment of this goal. Briggs writes that not everyone is interested in nutrition. He equates it to the practices of smoking, alcohol consumption or breaking traffic laws in that a certain percentage of the people will always do whatever it likes, no matter the consequences (36: 52). Guthrie states, concerning the possibility of eradicating obesity,

> As long as food, especially high-calorie food, tastes good, we will have problems with people who eat too much. As has been said, 'The kingdom of reason is but a pale shadow compared with the empire of delight'" (44:57).

Knutson writes that interest level is a key factor in learning. He writes,

> ...education has no effect on a complacent person, and...the individual must become dissatisfied or frustrated or at least curious regarding his present state of health affairs before he is likely to acquire an interest in doing something about it (15:65).

Results of the Canadian University Students' Nutrition

Misconceptions survey may point to lack of student interest as a contributing factor in the poor scores. McCarthy and Sabry reported,

> Taken together, misconceptions and "don't know" responses totaled 46%, a discouragingly high score in view of the opportunities for nutrition instruction in the elementary (grades 1 to 8) and secondary (grades 9 to 12) school curricula (54:193).

A survey by the School Health Education Study concurs with McCarthy and Sabry, reporting that less than half of the nutrition questions asked of participating twelfth grade students were correctly answered (26:58).

Development of nutritional programs which stimulate teenage interests may increase high school students' knowledge levels, but improving knowledge levels will not automatically solve poor nutritional habits. Schwartz and Picardi report that high levels of nutritional knowledge do not highly correlate with application of sound eating practices. A mini course for students, grades 11 and 12, at M.I.T. confirms these findings. There was no systematic behavior correlations between selected knowledge, attitude, and behavior categories found" (60:162).

It is evident that there is a need for improved nutritional instruction and curriculum which motivates students to adopt sound nutritional behaviors. White states

> The U.S. has been called a nation of nutritional illiterates. If this is the case, it is not because of lack of information about food and nutrition; it must be lack of

> motivation to avail oneself of the information.... Nutrition and health educators must be concerned with human behavior and therefore must compete with all internal and external forces that define and control how an individual behaves (78:54).

In order to motivate students, Moomaw writes, teachers need to get the students involved with "total nutrition." The practical experiences of food selection and preparation will begin to draw student interests (56:121). Teaching methods and subject content need to be relevant to the ability and needs of today's student.

Today educators have ample stores of nutrition knowledge from which to draw. White believes the basic knowledge is there, but educators have failed in distributing it:

> The state of knowledge of Americans is out of phase with the advance state of knowledge in the science of nutrition. Obviously much more is known about nutrition and human needs than is manifested by the current practices of our population (78:54).

Educators agree that, in spite of the past problems, there is still a need for nutrition education. The Nutrition Education in Elementary and Secondary Schools Panel stated, "This report recognizes both the urgency for immediate action to eliminate hunger and the need for a long-range program in nutritional education" (52:18). Sims writes that nutrition education can, besides imparting facts and concepts, help individuals develop better food practices (69:125). Todhunter feels each generation must be instructed in balanced food selection regardless of

incomes, education levels or cultural backgrounds. He states, "There is no instinct that guides man to select those foods which meet the nutritional need of the body. And knowledge is not inherited" (74:8). Briggs believes that nutrition education can influence the eating patterns of populations and can help eliminate malnutrition (36:52).

One health education project claimed fault for the lack of progress in nutrition education lies with the educator. Reporting that health education was falling far short of its great potential, the study concluded,

> The problem is not that health educators lack ideals, or alternatives of solution, or research capacity. Simply stated, the problem is that health educators failed to follow through (50:68).

To follow through or improve on established health curriculum, or to design and implement new programs, educators must first assess students' current nutritional knowledge status. The need to know where students stand in relation to the subject they are to be taught is fundamental to curriculum development. Selected nutrition educators attending the 1976 Society of Nutrition Education Annual Meeting responded to the question, "What are the needs of nutrition educators?" They stated that educators are "frustrated by the lack of background information on their audiences, especially regarding audience experience with and knowledge of nutrition principles" (37:60).

Sound nutrition practices are listed by the State of

Oregon as a goal for all high school students to attain during their school years. There follows a need to assess these students and evaluate their achievement of the selected nutrition education objectives.

The process of identifying, validating and setting priorities for learner objectives involves assessment. Concerning assessment of nutritional programs Guthrie comments,

> We would not promote a food or a class of foods without evidence of its contribution to good nutrition, and we should not cling to any method of education unless we have evidence that it brings about desirable habits of food consumption (44:57).

An assessment of the status of Oregon's high school students' nutritional knowledge can assist in the defining, shaping and evaluating of current concepts and methods.

Definition of Terminology

Assessment

Any means of taking inventory (103:8).

Achievement

1. Accomplishment or proficiency of performance in a given skill or body of knowledge (9:37).

Evaluation

The process of judging the value or amount of something by use of a standard of appraisal; includes judgments in terms of internal evidence and external criteria (9:220).

Evaluation Instrument

Any of the means by which one obtains information on the process of the learner and the effectiveness of instruction; quantitative and qualitative data, objective measures, subjective impressions, tests, observations, anecdotal records, case studies, and sociometric methods may all serve as instruments for deciding whether instructional objectives have been attained (9:221).

Health

A quality of life involving dynamic interaction and interdependence among the individuals' physical well-being, their mental and emotional reactions, and the social complex in which they exist (23:10).

Health Education

The process of education which includes physical, mental and social dimensions; knowledge, attitudes and practice aspects of behaviors; and individual, family and community relationships (23:8).

Measurement

The comparison of a quantity with an appropriate scale for the purpose of determining the numerical value on the scale that corresponds to the quantity to be measured (9: 357).

Nutrition

The science of food as it relates to optimal health and performance (19:5).

Objective

Aim, end in view, or purpose of a course of action or belief; that which is anticipated as desirable in the early phases of an activity and serves to select, regulate, and direct later aspects of the act so that the total process is designed and integrated (9:392).

Reliability

The consistency with which a test measures whatever it may measure (9:448).

Validity

The quality of being grounded on truth or fact. The extent to which a test or other measuring instrument fills the purpose for which it is used (9:635).

Summary

Although nutritional care in this country is improving, the problem of achieving nutritional balance is still considerable. Studies reveal substantial numbers of teenagers in this country have vitamin and nutrient intakes below dietary requirements. Nutrition instruction has not had a great impact on student nutritional knowledge, and information

alone has not insured sound nutritional behavior. In order to establish or improve school nutritional curriculum,there is a need to assess students' nutritional knowledge status.

The purpose of this study was to construct a valid and reliable instrument to assess Oregon high school students' achievement of selected nutrition objectives. This chapter presents the problem, its importance, scope and delimitations, and defines the terms used throughout the study.

Chapter II presents the findings of recent studies which assessed student nutritional knowledge.

Chapter III presents the methods and procedures used, an explanation of the resources from which information was obtained, and a description of the techniques used to gather the data.

Chapter IV deals with the organization of the data obtained during the investigation, including a discussion of the findings.

Chapter V presents a summary of the total investigation, conclusions, limitations and recommendations for future studies based on the findings.

II. REVIEW OF THE LITERATURE

This chapter presents the findings of research projects and tests which have assessed students' nutritional knowledge.

Assessment plays a prominent role in all areas of the instructional program. It can, according to Gronlund, aid both the teacher and student in assessing learner needs, monitoring progress, diagnosing weaknesses in the curriculum and learner, and evaluating the effectiveness of the programs (12:1). Fodor and Dalis also consider assessment to be of paramount importance in a rapidly changing society (7:102). Tyler writes that an essential ingredient in curriculum development is to examine the learner, the society in which he lives, and the body of knowledge (29).

It is by assessing student knowledge through objective means that the needs of the learner can be determined. Regarding assessment of nutrition education, Prefontaine writes, "To function effectively, nutrition educators need to gather information on how much a given population knows about nutrition" (62:152).

Prior to 1970 relatively few studies of nutrition knowledge of high school students had been reported in health literature. Of those studies published, most were simple surveys of specific populations or small high school

student samples. Instrument validation processes were generally not reported.

One major exception to these small studies was the School Health Education Study of 1967. Under the direction of Sliepcevich, a nationwide sample of 1,800 6th-, 9th- and 12th-grade students was assessed for health knowledge. Six items from the 75-item health test were concerned with nutrition. The findings, that the mean score of six items was 45 percent correct, indicated that high school students were nutritionally uninformed (26).

Results of smaller studies by Sutton (72), Harrison and Irwin (46:4), and Jacklin (83) showed similar findings of lack of nutrition knowledge. These studies are reviewed because of their contributions in providing impetus to much of the nutrition education research conducted in the 70's.

Eight of the items administered in Sutton's 1962 health test were concerned with nutritional misconceptions. Scores ranged from 33 percent to 66 percent correct. No sex, grade, or rural or urban differences were reported in the literature (72:347).

In 1964, 5,000 junior high students from Tennessee and Massachusetts participated in a nutrition misconception survey. Harrison and Irwin reported that the results of the 22-item test revealed a mean score of 54 percent correct. No sex, grade, or rural or urban differences were listed for the study. In the same year, a 57-item

questionnaire assessing food, nutrition and cooking knowledge was developed for Jacklin's doctoral dissertation (83). The sample was drawn from junior and senior high school students. Only grade differences were compared in this study. Of the 10th grade students who participated, a 56 percent correct response was recorded. These results were consistent with those reported by Harrison and Irwin and confirmed the nutritional misinformation findings by studies conducted in the 60's (46).

In 1970, Dwyer, Feldman and Mayer conducted a survey of 1,388 high school students in urban Massachusetts. The instrument, consisting of 100 three-option, multiple-choice items, measured students' nutrition knowledge and attitudes. The mean scores reported were only 54 percent correct for the males, and 58 percent correct for the females. The comprehensive test measured understanding of energy metabolism, intake and output, lipids and carbohydrates, protein, vitamins and minerals, and weight loss and gain (42:59).

Numerous nutritional misconceptions were reported in studies conducted by McCarthy, Salt, Tiffts and Osman. The samples for the Osman and McCarthy studies were college freshman health classes (58)(54). Salt and Tiffts administered their instruments to secondary school health students (89)(73).

The School Health Education Study, commonly considered one of the landmark developments in school health education

curriculum, devoted one of its ten concepts to food selection and eating patterns. This demonstrated a strong nutrition concern and, combined with the findings of other studies, opened the classroom door to nutrition education (105).

The National Education Association has also given much support to the need for a sound health education program in the schools. Concerning the importance, this statement was issued: "The content of health instruction belongs in the school curriculum because such knowledge is necessary, is most efficiently learned in school, and no other agency provides such instruction" (22:31). The American Association of School Administrators adds that it is imperative for a good school program to have a comprehensive and sequential curriculum of health concepts for all grade levels (57:37-51). Sinacore states that each school health program should complement the home economics department, with both offering nutrition education within their curriculum (70:2282). The State of Oregon, recognizing this importance of health and nutritional instruction, recently changed the health requirement for high school graduation from one semester to one full year.

Several recent nutrition studies reported on the effectiveness of the school health programs of the 70's. In 1974, Head developed and assessed a nutrition education program for grades 5, 7 and 10. His research revealed the high school students' cognitive and affective domains were the

least affected by the program of all grades studied (47:56). Doctoral research by Schwartz supports these findings. Three hundred and thirteen high school graduates who had completed a high school course in home economics were tested for nutrition knowledge, attitudes and behavior. Results showed that there was a low correlation between nutritional knowledge and dietary lifestyles (66:28).

Guthrie, Picardi and Dowell concur that information alone does not insure sound nutritional behavior. Picardi measured the effectiveness of a high school 20-hour nutrition course. Experimenting with rats, using a hands-on, scientific approach, 11th- and 12th-grade students studied the physical effects of various diets. Even though students visually observed the negative effects of poor nutrient intake, there was no change in their nutritional attitudes or behaviors. They were tested on the chemical constituents of food, relation between common dietary habits and health, use of food label information, and consequence of restricted fad diets (60:162).

Dowell concluded that there is a low correlation between health knowledge and behavior:

> We cannot expect health knowledge per se to bring about good health practices. Knowledge of what to do in terms of health practice is definitely an advantage, but falls well short of insuring that positive health practices will follow. The relationship between health knowledge and health practice is low indeed if we expect health knowledge alone to bring about good health practice.

> There is a need to re-evaluate our methods of teaching for good health practices (40:6).

The State of Kansas, in 1976, conducted a statewide assessment of students' health knowledge. College students who had completed a Kansas high school health class were administered the Fast-Tyson Health Knowledge Test. Eight items of the 100-item test covered nutrition and diet. Results showed that in questions over all the ten health concepts, students scored an average of 28 percent correct. The mean score on the nutrition questions was 14 points lower than any of the other concept scores. It was apparent that students were not digesting health instruction.

Tyler suggested that, in order to motivate students to learn and apply health knowledge, it is necessary to assess the learner's needs and interests:

> In this sense all children have the same needs and it is the responsibility of the school as with every other social institution to help children to get these needs met in a way which is not only satisfying but provides the kind of behavior patterns that are personally and socially significant. A study of such needs in a given group of children would involve identifying those needs that are not being properly satisfied and an investigation of the role the school can play in helping children to meet these needs. This may often suggest educational objectives in the sense of indicating certain knowledge, attitudes, skills, and the like, the development of which would help children to meet these needs more effectively (29:7).

In 1969, Byler, Lewis and Totman researched the health interests of high school students and found that they were

interested in knowing more about food and its effect on their health (3:118). Questions that were commonly asked by high school students revealed their need to be supplied with scientifically accurate information which is relevant to their lives. They wanted to know what is wrong with the typical teenage diet and how to avoid bad and/or diseased products (3:88).

Podell designed a nutrition curriculum in 1978 which succeeded in activating learner interest. Students in a 10th grade biology class focused upon nutritional principles related to cardiovascular health. Results showed a significant improvement in cardiovascular knowledge and related nutrition attitudes and eating patterns (59:573).

In general, educators and research studies concur with the recommendations established by the 1969 White House Conference on Food, Nutrition and Health that a comprehensive health education program should be established. It was stated that, "Sound nutrition education should enable each individual throughout his life to make wise decisions about his food choices" (32:147).

In order to construct and establish a relevant nutrition curriculum, it is necessary to assess students' present nutritional knowledge. Numerous high school and college health knowledge tests, those both currently available and

no longer in print, were reviewed, Primary references used to identify these tests included Solleder's book, Evaluation Instruments in Health Education (27), Mental Measurement Yearbook by Buros (2), and Completed Research in Health, Physical Education and Recreation by the American Alliance for Health, Physical Education and Recreation (5).

Of the tests reviewed, most contained only a minimal number of nutrition questions and only one consisted entirely of nutrition questions. The 33-item, four-option Kilander Nutrition Information Test was developed in 1942. Though twice revised, it still consists solely of basic definitions, nutritional related diseases and classifications of the basic four food groups. No statistical data was given nor are the validation procedures listed (85).

The Dearborn College Health Knowledge Test contained 15 nutrition items (80). This 100-item, five-option health test was validated over a 10-year period by 15,000 college students. The instrument was not, however, suitable for this research study as it was developed to assess the college student, and much of the content is limited and dated.

In 1975, Prefontaine developed a 25-item, four-option nutrition knowledge test. Under the direction of the Canadian Interagency Committee on Nutrition Education, she used this instrument in assessing the Canadian adult. Although validation statistics were reported, this instrument was

much too limited and its objectives too specific to be applicable to the high school student (62:152).

The 1962 Health Behavior Inventory (84) measured nutrition in one of its ten health concepts. Johns and Pollock developed this 75-item, five-option test to assess secondary school student health knowledge. Kirk, Hamrick and McAfee, using this instrument for a research project in Tennessee, reported that from the 1,153 students tested, the nutrition knowledge section showed the lowest scores of all ten subtests. The mean nutrition score was 44 percent correct (50:69).

Doctoral research by Skinner determined teacher characteristics which contributed to an effective nutrition education curriculum and assessed student nutrition knowledge and behavior. The 33-item, four-option test was classified into five categories: basic knowledge, advanced knowledge, applied knowledge, recent knowledge, and insignificant information (90:45). This instrument, administered to various Oregon health and home economics classes, was not applicable to this research in that it failed to list or validate any behavioral objectives. Also, because the test items were adopted from a college nutrition class, this instrument was not considered appropriate for a nutrition assessment of the high school student.

In conclusion a survey of existing nutrition tests both currently in use and out of print revealed no instruments

appropriate for this study. As a result, there was a need to construct and validate an instrument to assess student achievement of selected nutrition objectives. Veenker comments on the value of testing by stating, "Appropriate testing procedures yield significant information basic to effective health education curriculum construction" (77:31). Dwyer concurs by writing,

> ...using the criteria of poor performance on an objective test of nutritional knowledge as a guide, it might be possible to identify some of the demographic characteristics of students who were most in need of further nutrition education (42:59).

Summary

A review of the literature revealed numerous tests and research projects assessing students' nutritional knowledge. However, most of the reviewed instruments measured the effectiveness of specific nutritional concepts, were only subtests contained within standardized health tests, measured nutrition misconceptions, were outdated, measured nonsecondary school students, or did not reveal validation procedures and/or statistics. Therefore, it was concluded there was a need to construct and validate a test which would measure secondary school students' achievement of selected nutrition objectives.

III. METHODS AND PROCEDURES

A variety of resources was used to obtain the information necessary for the construction of the instrument. A review of recent publications concerning nutritional education provided the information needed to secure the data for making predictions. This review included 1) state and local high school curriculum guides concerning nutrition education; 2) professional periodicals relating to testing, nutrition education and/or curriculum design; 3) curriculum materials developed by health-related professional organizations; 4) textbooks and references concerning nutrition; and 5) dissertation abstracts from 1969 through 1978. All related tests known to be in print or currently being used were obtained and analyzed for form and content.

Written correspondence was used to contact and submit the instrument to the validating committee. Their criticisms were analyzed, synthesized and implemented into the final instrument. After testing, scores were statistically analyzed and recorded in appropriate form.

General Procedures for Test Development

Acceptable principles of test construction were identified and researched before actual test construction began. The research revealed many similarities in the writings concerning the construction of assessment instruments. The most practical method, and the one used in this investigation, was outlined by Gronlund (11). He explains a systematic approach to planning the test.

Gronlund asserts that the initial step in planning the construction of an instrument is to research all relevant literature to determine the content and to establish, or secure, the desired objectives:

> The systematic planning of a standardized achievement test includes identifying the instructional objectives and content to be measured, determining the relative emphasis to be given to each objective and each area of content.... To provide some assurance that this is the case, a careful study is made of the most widely used text book or representative courses of study, of the recommendations of curriculum specialists, and of the research literature pertaining to the area (11:265).

Instructional objectives from the School Health Education Study, concept ten, levels three and four were selected and used for the development of the instrument.

The second step in planning the construction of a test is a two-part procedure. First, there is the importance of matching the behavior and content of the question to that of the specified objective. For example, if an objective

calls for the student to compare and/or contrast, the items under that objective must be written to involve a comparing or contrasting process. Gronlund writes:

> The preparation of test items involves the writing of items that directly measure the instructional objective (11: 267).

Second, after the objectives and questions have been correlated, there is a need to have experts, competent in test construction and/or in the specific content areas of the objectives, review the preliminary instrument. Gronlund states:

> When a sufficient pool of items has been prepared, the items are then edited by trained item writers and assembled into the experimental form of the test. This experimental edition, or pretest, includes directions, test format, time limits, and scoring provisions as similar as possible to those desired in the final edition (11:267).

The third step in planning the construction of a test is to analyze statistically each item of the trial instrument. Gronlund suggests that the difficulty rating, index of discrimination, functioning of responses, and the adequacy of the directions, time limits and test format be analyzed (11:267).

Finally, he concludes that the revised instrument should be administered with the purpose of establishing norms (11:267).

Specific Procedures for Test Construction

The purpose of this investigation was to construct an instrument to assess student achievement of selected nutrition education objectives. The following is an overview of how this was achieved.

The following authors and sources were reviewed: Blyer, Lewis, and Totman (3), Clydesdale (4), Ellis (81), Guthrie (44), Lamb (16), Martin (18), Mayer (19), The Oregon Department of Education, Nutrition and Foods (103), Picardi (61), The School Health Education Study (105), Schwartz (66), Bogart (94), and those health curriculum guides listed in Section D of the bibliography. A list was made of the content areas that were commonly considered to be important to the high school student by the majority of these sources. These content areas were found to be covered in a previous health education study. Therefore, objectives developed by the School Health Education Study, concept ten, levels three and four, were selected and are listed in Appendix A.

The type of instrument to construct was the next concern. An investigation of evaluation and measurement processes revealed that for achievement or knowledge tests the multiple-choice question is the most desirable. Ebel states,

> Multiple-choice test items are currently the most highly regarded and widely used form of objective test item. They are

> adaptable to the measurement of most important educational outcomes--knowledge, understanding, and judgment (6:149).

Ebel suggests the following criteria be followed when constructing a multiple-choice instrument.

1. Is the test item a meaningful statement with important ideas?

2. Does the question maximize discrimination power?

3. Does the test item begin with a stem question or incomplete statement to which a reasonably adequate answer can be given and for which a plausible wrong answer can be found?

4. Is the correct response clearly adequate and thoroughly correct?

5. Is the item written concisely, without providing clues which may give away the answer to the clever student?

6. Are the distractors thoroughly wrong or clearly inadequate, yet plausible enough to be chosen?

7. Is the item worded as clearly, simply, and correctly as possible (6:198)?

Strict adherence to these standards was observed in the construction of each multiple-choice item in the instrument.

The test length was governed by the fifty-minute time of the average high school class meeting. Since Ebel suggests that for preliminary testing there should be at least one and one-half times the desired number of items, a goal of 75 test items was planned for the first trial instrument,

of which 50 would be desired for the final instrument. A 75-item, five-option, multiple-choice test was constructed and used for the first trial instrument.

Furst recommends that the test questions be grouped by subject matter or objectives:

> Certainly one of the most meaningful ways of grouping questions is according to subject matter with which they deal. It is easy to accomplish. It makes the examinee's task easier in that they can concentrate on one area at a time (8:277).

Questions on the instrument were grouped according to their objectives.

The distribution of questions for each objective for the second trial instrument was: objective one, six; objective two, eight; objective three, eight; objective four, eight; objective five, eight; and objective six, twelve.

Validity and Reliability

Before any meaningful generalizations can be made, the instrument providing the data must demonstrate both validity and reliability. The following is a discussion of the test's validity and reliability, and how these essential qualities were proven.

Validity

The validity of an evaluation device is the degree to which it measures what it is intended to measure (28:160).

Cureton, on the subject of validity, states,

> The essential question of test validity is how well a test does the job it is employed to do. The same test may be used for several different purposes, and its validity may be high for one, moderate for another, and low for a third. Hence, we cannot label the validity of a test as 'high', 'moderate', or 'low', except for some particular purpose (17:621).

Although many textbooks discuss and classify validity in different ways, the American Psychological Association, the American Educational Research Association and the National Council of Measurements have collectively agreed upon three basic types of validity. These three are called "content validity," "criterion-related validity" and "construct validity" (1:119).

While construct and criterion-related validity are necessary for many types of testing, Green states that, "In achievement tests, the basic concern is with content validity" (10:64). Thorndike and Hagen support this concept and underline the importance of matching the objectives with the content of the test. They write,

> We must examine the test to see what skills, knowledge and understanding it calls for. Finally, we must match the analysis of the test content against the analysis of course content and instructional objectives and see how well the former "represents" the latter. In proportion as the outcomes that we have accepted as goals for the course are represented in the test, the test is valid (28:161).

Scott suggests that a test's content, or curricular, validity can be determined by merely matching the content

of the questions to the objectives specified. She states,

> If the test's author intends to construct his own test, he can demonstrate curricular validity by showing that the items of the framework cover the statements of the course objectives and course outline (24: 224).

Cureton enlarges upon this concept by asserting that there must be a direct relationship between what is stated and what is to be tested. He writes,

> When the objectives of a unit or subject can be stated explicitly in terms of knowledge, skill, and information, it is usually possible to construct a test measuring the achievement of these objectives by the students, and such tests possess high curricular relevance (17:621).

While content validity is necessary in the construction of the instrument, statistical validity demonstrates whether the instrument is actually measuring what it was intended to measure. Green states,

> Content validity is not alone a sufficient index of a test's usefulness. Such consideration as choice of items, extent of sampling, level of difficulty, and discrimination index are also very important (10:32).

Ebel suggests a two-step approach be used in determining statistical validity (6:421). The first step is to evaluate the test through use of opinions obtained from qualified experts in the field. The second step, an item analysis, involves conducting a statistical investigation of each test item (6:422).

In Appendix B is a list of those experts who participated in this investigation. They were asked to rate each

test item on a one-to-five scale, with five representing a very good question. Correspondence with validation committee members is listed in Appendix C.

To complete the validation process, according to Ebel's suggestions, an item analysis was conducted. Computer assistance was secured by a grant from the Unsponsored Research Committee at Oregon State University. The analysis included the computation of a test mean, a standard deviation, a standard error of measurement, a difficulty rating, an index of discrimination and the functioning of responses (see Appendix E).

Difficulty Rating

"The difficulty index of a test item is usually based on the proportion of examinees in a group who answer the test item correctly" (6:449). The higher the percentage of those choosing the correct response, the lower the difficulty of that item.

Scott reports: "A test item is difficult if most students fail it, and easy if most respond correctly" (24:231). Her suggestion of establishing limits between ten and 90 percent as the range of difficulty indices was used. She explains why this is useful.

> Because of the effect of difficulty upon validity, there appears to be some advantage in having the difficulty ratings concentrate around fifty percent. On the other hand, a spread between 10 and 90

> percent will tend to insure discrimination at all levels of ability (24:231).

Discrimination Index. Ebel defines the discrimination index as:

> ...a means of the extent to which students who are judged to be good in terms of some standard succeed on the item and those who are judged to be poor on the same standard fail it (6:449).

Scott suggests that the Flanagan Index of Discrimination method is suited to the knowledge test. She states:

> The Flanagan Index of Discrimination yields a product-moment coefficient of correlation which indicates how well a test item differentiates good and poor performance. The correlation coefficient is high when the item is answered correctly by those who score low on the total test. When high and low scores do equally well on a test item, the item coefficient is low (24:226).

Green writes about the statistical criteria for the Flanagan Index of Discrimination, stating:

> The discrimination index ranges from +1.00 to -1.00, but only items which show positive indices should be retained. A discrimination index above +.40 is desirable (10:209).

Ebel, however, cautions against discarding good items which do not possess high discrimination indices. He suggests:

> The preference for items which show a high index of discrimination should not be pushed to the point of excluding from the test those items which are clearly relevant to some aspect of the achievement to be measured by the test, but cannot be made to yield a high index of discrimination (6:359).

He concludes by stating that those items which possess a

high degree of relevance but are low on the discrimination index are most likely in need of slight revision (6:359). According to Green, a discrimination index is desirable at +.40 and up. Scott suggests that an item with a +.20 is satisfactory and acceptable. Yet, both writers agree that those items falling between the +.15 and +.20 mark should be given careful consideration before usage.

Functioning of Responses. One strength of a multiple-choice test is that it has many possible responses. To improve the validity and minimize guessing, this instrument had five-answer alternatives or choices. Those answers not selected by at least three percent of those taking the trial test were considered as nonfunctioning and in need of revision. An examination of the item difficulty aided in determining some reasons for extremely high or low responses. Ebel suggests that each alternative be plausible enough to be chosen.

> Choose and phrase incorrect alternatives (distractors), so that they are thoroughly wrong or clearly inadequate, yet plausible enough to appeal to substantial numbers of poorly prepared examinees (6:164).

Another important concept to be considered while attempting to establish content validity is the "face validity," or how the test appears. Cureton writes that face validity may not be essential to the layman who is participating in the sample population.

> A test is face valid if it "looks" valid--

> particularly if it looks valid to the layman. Face validity is often important in the public relations aspects of certain types of test programs, but as a validity concept it merely reflects inadequate or superficial analysis (17:670).

Caution was taken in developing the face validity of the instrument to insure general public acceptance.

In conclusion, Furst suggests three techniques for the final validation process of a knowledge test.

1. Keep both the test directions and recording documents as simple as possible.
2. Increase the number of response options, thus reducing the chance of guessing.
3. Use a mechanical recording device to enhance accuracy (8:142).

The statistical methods of validity are presented and discussed in Chapter IV.

Reliability

The second integral part of an assessment instrument is its reliability. Remmers, Gage and Rummel define reliability as the "consistency with which a test yields the same results in measuring whatever it does measure" (21:125). Ebel explains that reliability helps to insure test validity.

> Reliability is a necessary condition for quality in an educational achievement test, but it is not a sufficient condition (6:309).

Remmers, Gage and Rummel further illustrate this relationship between validity and reliability by writing:

> What a test measures may not be what it is being used to measure; i.e., a test may be invalid, but if it yields consistent results, it is reliable. If height is used as a measure of intelligence it will be reliable--because height measured with a yardstick is very consistent--but it will not be valid for that purpose (21:126).

The significance of the reliability coefficient is asserted by Ebel in the following:

> For most tests of educational achievement the reliability coefficient provides the most revealing statistical index of quality that is ordinarily available (6:308).

He continues, "Only to the degree the test scores are reliable can they be useful for any purpose whatsoever" (6:309).

Remmers, Gage and Rummel elaborate on how high the percent of the reliability coefficient should be. They suggest:

> Most standardized tests published for school use (achievement, primarily) have reliability coefficients of at least .80 in the population for which they are designed. For research purposes tests may be useful if their reliability coefficients fall as low as .50 (21:132).

Scott lists many factors which can influence a test's reliability coefficient.

> Reliability can be influenced by such extraneous factors as the time of day, the equipment, momentary attitude of the subject, conditions in the surrounding area, such as heat, light, and humidity, and lack of specific directions for performing the test. When these and any other extraneous factors are controlled, reliability improves (24:243).

She also suggests that if the students' abilities vary

greatly, the reliability coefficient is likely to be high (24:243).

Furst has five suggestions for improving reliability.

1. There should be five alternatives.
2. The directions should be clear and concise.
3. Items which are too difficult or too easy should be replaced.
4. Poorly or negatively discriminating items should be replaced.
5. The length of the test should be increased (8:199).

The reliability of a test, usually symbolized by the letter "r," is obtained by correlating two sets of scores. This can be accomplished by using one of the following methods.

One method is to use identical test items in a test-retest procedure. Retesting has its practical limitations, however, and is not considered a desirable way to determine a reliability coefficient (1:25). Furst adds to this opinion by stating,

> Repeating the test at too short an interval gives spuriously high coefficients because individuals tend to remember their responses on the first occasion. Repeating the test at too long an interval does not give a true estimate of reliability, for the test is in all likelihood assessing permanent changes in the individual concerned (8:319).

Another method employed is to use one of several proven statistical formulas, such as the Kuder-Richardson formula. Remmers, Gage and Rummel suggest, however, that there are better alternatives in determining test reliability. They write,

> For achievement tests it is usually better to estimate reliability with one of the split-half coefficients than the Kuder-Richardson formula (21:130).

The Kuder-Richardson method is limited in that it necessitates homogeneity of all test items. Gronlund explains.

> Kuder-Richardson estimates of reliability assume that the items in the test are homogeneous. That is, each test item measures the same quality or characteristic as every other (11:107).

Because there were eight distinctive characteristics being measured in this instrument, this method of determining reliability was not applicable.

A third method used to determine the reliability of an instrument is the equivalent forms. This method requires that once a test has been administered, a similar, yet not identical, test should be immediately administered. The resulting sets of scores would be correlated to determine the reliability coefficient.

A final method, and the one used in this investigation, is the split-halves. Scott describes this method by stating,

> Using one administration of a single test, the investigator correlates the sum of the odd-numbered questions with the sum of the even-numbered questions (24:235).

Remmers, Gage and Rummel expound upon the advantages of this method by explaining,

> This usually makes the two scores obtained from a single testing reasonably equivalent in such respects as practice, fatigue,

distractions, boredom, mental set, item difficulty, and content (21:127).

The statistical method used to determine the reliability of the instrument is presented and discussed in Chapter IV.

Procedures for the Development of the Instrument

Several procedures were used in developing the nutrition education instrument prior to the final administration of the test.

A pilot test of 75 five-option, multiple-choice questions was administered to 40 high school students at Crescent Valley High School, Corvallis, Oregon. This study served as a guide for establishing content for the multiple-choice questions in the trial instrument.

Six Oregon high school health instructors and three college professors from Oregon State University's Foods and Nutrition Division of the Department of Home Economics evaluated the 75 multiple-choice test questions. They evaluated the accuracy of the information and detected inappropriate or difficult wording for high school students. From their suggestions, a 70-item, multiple-choice test was constructed and then administered to 300 students in three Oregon high schools.

The students were instructed to read all of the alternatives before choosing the best answer and to select

the one that seemed best to them. They were informed that they had the entire class period to finish the test and could go back and check their answers as time permitted.

The resulting data were analyzed to determine:

1. test mean;
2. standard deviation;
3. difficulty rating;
4. index of discrimination;
5. functioning of responses; and
6. reliability of coefficient.

An item analysis revealed 20 items functioning at a moderate to low level of validity.

This testing served again to determine if the wording of the test items was on too technical a level for the average high school student. It also provided information for the amount of class time needed to complete the test. It was concluded that a 50-minute class period was necessary for the administering of the trial instrument.

Table 1 lists the general descriptive data and Table 2 lists the item analysis from the first trial instrument.

Use of Panel of Experts

Crucial to the completion of the validation process is the use of a panel of experts to evaluate the relationship between the stated objectives and the actual content of the test items (21:120).

Table 1. General descriptive statistical data (first trial administration).

Number of subjects	300
Mean score	30.81 (44%)
Median score	31.00
Mode score	36.00
Standard deviation	11.09
Range of scores	8-56
Test Reliability	
Split-halves	r= .893

Table 2. First trial instrument, item analysis (N=300).

Difficulty Rating	Frequency	Percent
.00 - .04	0	00
.05 - .14	2	03
.15 - .24	9	13
.25 - .34	7	10
.35 - .44	18	26
.45 - .54	13	19
.55 - .64	11	15
.65 - .74	9	13
.75 - .84	1	01
Total	70	100

Index of Discrimination	Standard	Frequency	Percent
.41 - up	25% or more	24	34
.21 - .40	25% or more	33	46
.01 - .20	15%	10	15
-.20 - .00	5%	3	5
Total	100	70	100

The first trial instrument was sent to 20 experts in the fields of test construction, health education and nutrition. These experts were chosen on the basis of one or more of the following criteria. Those who are:

1. actively contributing to the field of nutrition education in one of the following ways: teaching, research or publications;

2. acknowledged experts in test construction and/or the evaluation process;

3. members of a health related organization; specifically those organizations concerned with nutrition education; and/or

4. medical or professional specialists who deal with problems of nutrition.

Of the selected experts, many could be classified under more than one of the preceding four categories.

The panel was asked to identify and respond to the following questions.

1. Is the test question vague or unclearly stated?

2. Is the "correct" answer scientifically sound?

3. Does the test question concern information either unimportant or inappropriate for high school students?

They were also requested to rate each test question on a one to five scale, with one being very poor and five being very good.

Second Trial Student Sample

A large sample of high school students was needed to fulfill the purpose of this investigation, to minimize sampling error and to develop norms.

To obtain a representative sample of the population, Van Dalen suggests: 1) defining the population; 2) procuring an accurate and complete list of the population; 3) drawing representative units from the list; and 4) obtaining a sufficiently large sample to represent the characteristics of the population (30:318). In accordance with his suggestions, the population of this study was limited to students attending Oregon public high schools. A list of the names, locations and present student body sizes of these schools was provided by the Oregon Department of Education. A standardized table of random numbers was used to select the high schools. Seventy-three high schools were selected and contacted. A goal of a 5,000 student sample, which was ten percent of the 73 schools' student body was established.

"Cluster Sampling" was used in the selection of participating students. The superintendent of each school randomly selected the classes from a variety of courses to participate in the sample. According to Van Dalen, there are numerous advantages to this method of selection. He states, "Observing clusters of units in a few schools

is easier and less costly than observing randomly selected students scattered in many schools" (30:323).

Second Trial Administration

On the basis of the first trial administration and the recommendations of the panel, the second trial test was revised down to 50 items. These items were edited for sex discrimination and potentially controversial issues by the Oregon Department of Education. Items which failed to meet acceptable standards were deleted or revised. A readability assessment was conducted on the revised instrument. Results of this assessment are discussed in Chapter IV.

The second trial instrument was administered to 60 Oregon high schools. For ease in administration participating classes were selected by individual school administrators. Thirteen high schools declined the invitation to be surveyed. The test was administered by a school faculty member during a regular class period.

To obtain further evidence of test validity, the instrument was administered to 87 college students in three personal health classes at Oregon State University and 13 college students who had completed a three-unit college course in human nutrition. It was expected that college students would score significantly higher than the high school participants.

The response sheets were processed by the testing services, a department of the Computer Center at Oregon State University. The data were presented to ascertain means, standard deviations, standard error of measurement and other statistical data necessary for the determination of test validity and reliability. Chapter IV will discuss the results of the second trial administration.

Summary

This chapter was composed of two parts, the first on the general procedures in test construction and research, and the second on the specific procedures used to secure the data in this investigation.

The theory of test construction was discussed. Four methods of constructing an assessment instrument were described. The sequential development of these methods, as they related to this study, the study objectives, the content outline, and the pool of test items, was explained.

An overview of the methods of securing the essential qualities of validity and reliability was included. Because it was shown to be most applicable to achievement tests, "content validity" was selected for use in this instrument.

The criteria used in selecting the panel of experts were outlined, as were the criteria given for their analysis of the questions.

In Chapter IV the statistical procedure applied to the trial instrument will be presented and analyzed. Chapter V will include the summary, limitations, conclusions and recommendations of the study.

IV. RESULTS AND DISCUSSION

The primary concern in this chapter is to demonstrate statistically, using standard testing procedures, both the validity and reliability of the nutrition instrument. The data obtained from the administration and analysis of the second trial instrument were reported in this chapter.

First Trial Instrument

The first trial instrument was administered to 300 high school students in Oregon during the 1978 fall semester. To insure a representative sample, the Oregon School Activities Association standard for size of school was used. A small school, A, is defined to have an average daily student enrollment of 200 or less; a medium school, AA, has an average daily student enrollment of 201 to 600; and a large school, AAA, is any school with more than 600. Size A, AA and AAA schools from three counties were selected for participation.

Correct test answers were ascertained by three professors of Food and Nutrition at Oregon State University. Each test item was equal in value and was scored a "1" for the selection of the correct answer or a "0" for an incorrect answer. As Ebel suggests, there was no penalty assessed for guessing. He states that there is little value in applying any one of the formulas to compensate for guessing. He writes,

> Scores corrected for guessing will usually rank the examinees in about the same order as the uncorrected scores.... The probability is small of getting a respectable score on a good objective test by blind guessing alone (6:237).

For the first trial test the raw scores ranged from eight to 56 out of the 70 possible. The difficulty rating varied from .09 to .78 and discrimination indices ranged from -.15 to +.61. All 350 alternatives were considered functioning as they were selected by at least two percent of the examinees.

Second Trial Instrument

The second trial instrument was administered to 4,518 students attending 60 high schools in Oregon. Table 3 lists the general descriptive data for the second trial administration. A statistical description of those students participating in the second trial administration is given in Tables 4a through d.

Table 3. General descriptive data.

	Total Test	Males	Females
Sample size	4,518	2,081	2,436
Mean	27.677	25.378	29.640
Standard deviation	9.333	9.620	8.611
Standard error	1.679	1.683	1.816
Range of scores	1 - 49	1 - 47	6 - 49

Table 4. Tabulated summary of results.

	Number	Mean Score	Standard Deviation	Range
a. Subjects by age				
14	368	25.51	8.71	7 - 45
15	911	26.28	9.14	5 - 48
16	1,291	27.67	9.35	1 - 47
17	1,220	29.03	9.39	4 - 46
18	530	29.13	9.17	6 - 49
Total	4,400	27.75	9.33	1 - 49
b. Subjects by sex				
Males	2,081	25.37	9.62	1 - 47
Females	2,436	29.64	8.61	6 - 49
Total	4,517	27.67	9.33	1 - 49
c. Subjects by grade				
9	891	24.56	9.04	6 - 47
10	1,327	26.99	9.26	4 - 48
11	1,390	28.70	9.29	1 - 47
12	900	30.28	8.73	6 - 49
Total	4,508	27.69	9.33	1 - 49
d. Subjects by size of school				
A	523	26.42	9.41	4 - 47
AA	827	26.76	9.29	5 - 45
AAA	3,134	28.14	9.29	1 - 49
Total	4,489	27.68	9.33	1 - 49

Validity and Reliability

Before any generalizations can be drawn, the instrument providing the data must be shown to demonstrate a high degree of validity and reliability. Ebel's two-step approach to determine statistical validity was used to ascertain these essential qualities. He suggests a panel of experts examine the test and an item analysis be conducted.

Panel of Experts

Thirteen of the 20 selected experts reviewed the revised instrument and responded by correspondence. The panel responded to four questions.

First, each test question was to be rated on a one-to-five scale, with one being very poor and five being very good. Table 5 lists the average of the panel members' rating of each item.

Table 5. Panel members' ratings of each item.

Item	Average	Item	Average	Item	Average
1	3.00	24	3.16	47	3.08
2	3.30	25	3.92	48	3.30
3	3.84	26	4.24	49	4.48
4	3.84	27	3.46	50	3.76
5	3.00	28	3.46	51	3.30
6	3.62	29	3.62	52	3.62
7	3.92	30	3.00	53	4.24
8	3.30	31	3.84	54	3.62
9	3.38	32	3.78	55	4.24
10	3.78	33	3.62	56	4.08
11	3.22	34	3.78	57	2.38
12	3.62	35	3.54	58	3.92
13	4.16	36	4.40	59	4.00
14	3.62	37	3.84	60	2.30
15	4.00	38	3.76	61	3.70
16	3.70	39	4.32	62	4.16
17	4.61	40	4.61	63	3.84
18	3.30	41	4.48	64	3.62
19	3.22	42	3.92	65	3.70
20	4.08	43	3.92	66	3.08
21	2.92	44	3.22	67	4.08
22	3.38	45	3.84	68	3.15
23	3.70	46	4.24	69	3.70
				70	3.30

Out of a possible 5.00, the mean score was 3.67, with a range from 2.30 to 4.61. Items with an average score of less than 3.00 were omitted. Three items did not meet the acceptable level and were eliminated. The frequency distribution of the panel members' mean score is listed in Table 6.

Second, each member was asked to judge the scientific accuracy of every item. Six items were eliminated because one or more panel members questioned their scientific accuracy.

Table 6. Frequency distribution of panel members' ratings of each item.

Range	Frequency	Percent	Range	Frequency	Percent
4.75-5.00	0	0	3.25-3.49	11	16
4.50-4.76	1	1	3.00-3.24	10	14
4.25-4.49	4	6	2.75-2.99	1	1
4.00-4.24	11	16	2.50-2.74	0	0
3.75-3.99	17	24	2.25-2.49	2	4
3.50-3.74	13	18	Total	70	100

Third, the panel was asked to identify if the test question was vague or unclearly stated. Several suggestions to improve clarity were noted and implemented.

Finally, the panel responded on the appropriateness or importance of the information for high school students. No items were judged either unimportant or inappropriate.

From data gathered from the first trial administration and the panels' suggestions and recommendations, 20 of the 70

items were omitted from the test.

Results of the Readability Assessment

A Fry readability assessment of the test directions and final 50 items was conducted by the Oregon Department of Education. Ten samples of 100 words were computed to measure grade reading level. Average results revealed the test to be operating at the 9.1 readability level. This figure is within the accepted reading level for high school assessment. Statistical validation is viewed as an extension of subjective and expert validation.

Difficulty Rating

Table 13 in Appendix E, lists the difficulty indices for the second trial administration. These indices represent the percent of the number of students correctly answering each item. The average rating was .56, or 56 percent of the sample answered the question correctly. The range of difficulty indices was between 18 and 84 percent. This was, according to Scott, within the acceptable limits. Because all 50 items met specified statistical criteria, no item was considered inappropriate for high school students. Table 7 lists the frequency distribution of the difficulty indices.

Table 7. Frequency distribution of difficulty indices.

Range	Frequency	Percent
.90-1.00	0	0
.80- .89	3	6
.70- .79	11	22
.60- .69	6	12
.50- .59	11	22
.40- .49	8	16
.30- .39	8	16
.20- .29	2	4
.10- .19	1	2
.0 - .09	0	0
Total	50	100

Functioning of Responses

Each item of the second trial instrument contained five alternatives, or responses. The frequency of response range was 2.3 to 85 percent. Table 15 in Appendix E lists the frequency of each alternative selected by the student sample.

While only one response is correct, all five options must be plausible enough to be chosen. A 50-item, five-option test has 250 possible responses. Two alternatives not chosen by at least two percent of the sample were considered not functioning. Since both alternatives were located in the fifth or last position, it is possible that some students failed to consider all the responses before selecting an answer.

Discrimination Index

The Flanagan Index of Discrimination method was used to identify the discriminating power of each test item. This

figure is computed by comparing student test scores from the lower 27 percent and the top 27 percent of all those required.

According to Ebel, high discriminators have indices of .41 or higher, moderate are between .21 to .40 and low have between .01 to .20 (6:281). Table 14 in Appendix E lists the discrimination indices for the second trial administration. The indices ranged from .14 to .71 for the second trial administration. All 50 items discriminated positively, with 45 items above the .20 mark. Ebel suggests that low discrimination indices should not be the only reason to eliminate an item (6:283). Although five items had a low discrimination index, they were retained because they satisfied all other statistical criteria and were considered important by the panel of experts. Table 8 lists the frequency distribution of the discrimination indices.

Table 8. Frequency distribution of discrimination indices.

Range	Frequency	Percent
.41-1.00	35	70
.20- .40	10	20
.14- .19	5	10
Total	50	100

Reliability Index

The reliability index of the second trial administration was calculated by the use of the split-halves formula. Fifty test items were divided using the odd-even number

split-halves method. For the second trial administration, the reliability coefficient was .820, which, according to Ebel, is considered extremely high. Since this value represents one-half the test, the Spearman-Brown Prophecy Formula was applied to estimate the reliability of the total test. It was computed to be .899.

Since reliability conclusions from a highly heterogeneous sample can be misleading, Table 9 lists the reliability coefficient for each level of grade and sex.

Table 9. Reliability indices.

	Reliability for half test	Spearman-Brown Prophecy
Total test	r = .820	r = .899
Sex		
Males	r = .825	r = .904
Females	r = .789	r = .882
Grade		
9	r = .798	r = .887
10	r = .808	r = .894
11	r = .819	r = .901
12	r = .804	r = .892

Standard Error of Measurement

Although all data resulting from testing is subject to error, the extent of error can be predicted by the standard error of measurement. This measurement employs computing standard deviation times the square root of one

minus the reliability coefficient. For the second trial test the standard error of measurement was computed as 1.679.

Another method used to demonstrate test validity was to compare the achievement of 87 college students at Oregon State University to that of the high school sample. Presumably, if the instrument was both valid and reliable, it would discriminate between those students in college (assumed to possess more life experience and subsequently more nutrition knowledge) and those students in high school. The mean score for the college students was 37.70, with a standard deviation of 4.89. The college students averaged ten points, or 37 percent, better than the high school sample. A "t" test yielded a t value of 21.02, which is significant at the $p \leq .01$ level in favor of the college students. This indicated that the test was operating as hypothesized.

Test scores from 13 college students who had completed a college course in nutrition were also compared to the high school sample. The mean score of this group was 41.23, with a standard deviation of 4.22. Their score of 14 points, or 51 percent, better than the high school sample supported the premise that the test discriminates between those students who are knowledgeable in nutrition and those assumed to know less nutrition information. This also indicated that the test was valid and reliable.

Results of the Data

The sample included 4,518 students from 60 high schools randomly selected within the state of Oregon during the 1979 spring term. Examination of age showed eight percent of the sample to be 14 years old, 23 percent were 15 years old, 30 percent were 16 years old, 28 percent were 17 years old and 12 percent were 18 years old. Two percent of the sample did not state their age (see Table 4a).

An analysis of variance test revealed a significant difference between age groups. Table 10 identifies the subsets and where the significance occurred. If, for example, there were two ages listed in a subset, there was no significant difference found between their mean scores. For the groups in the other subsets, there was, at the .05 level of significance, a significant difference between the mean scores. Regarding ages, the 17- and 18-year-old students scored significantly better than the other age groups.

The 16-year-old students also scored significantly better than the 14- or 15-year-old students. Although there was no significant difference between the mean scores of the 14- and 15-year-old students and the mean scores of the 17- and 18-year-old students, the mean scores consistently increased with age. This data supported the concept that nutritional information increases with age.

Examination of sex showed 47 percent of the sample were male and 53 percent were female. The mean score for test

Table 10. Analysis of variance, second trial. (N = 4,518.)

a. Age and mean score

Subset I	Age 14	(25.51)	Age 15	(26.28)
Subset II	Age 16	(27.67)		
Subset III	Age 17	(29.03)	Age 18	(29.13)

b. Sex and mean score

Subset I	males	(25.37)
Subset II	females	(29.64)

c. Grade and mean score

Subset I	Grade 9	(24.56)
Subset II	Grade 10	(26.99)
Subset III	Grade 11	(28.70)
Subset IV	Grade 12	(30.28)

d. Size of school and mean score

Subset I	A	(26.42)	AA	(26.76)
Subset II	AAA	(28.14)		

performance was 25.37 for the males and 29.64 for the females. An analysis of variance test was performed, and there was a significant difference between the mean scores of both sexes. The females scored 16 percent better than the males.

Four grade levels were represented in this study. Twenty percent of the sample were in ninth grade, 30 percent were in tenth grade, 30 percent in eleventh grade and 20 percent in twelfth grade. An analysis of variance test revealed a significant difference between each grade level, always in favor of the upper grade (see Table 10).

Sixty schools throughout the state participated in the survey. Thirty percent of the schools were A, 28 percent were AA, and 42 percent were AAA. An analysis of variance test demonstrated a significant difference in mean scores, with the AAA schools scoring higher than the AA and A schools. There was no significant difference in mean scores between the AA and A schools. Assuming that the AAA schools were urban, A schools rural and AA schools both urban and rural, there was a significant difference between the mean scores of urban and rural students, with the urban students scoring higher.

The Objectives as Subtests

This instrument was designed to measure six different objectives. Table 11 lists the data pertaining to the six

Table 11. Objective analysis, second trial.

Objective Number	Number of Questions	Total Mean Score	Total Percent Correct	Total Male Mean Correct	Percent	Total Female Mean Correct	Percent
1	6	4.04	67	3.85	64	4.20	70
2	8	3.15	39	2.96	37	3.30	41
3	8	4.98	62	4.69	59	5.21	65
4	8	4.59	57	4.17	52	4.92	62
5	8	4.81	60	4.17	52	5.33	67
6	12	6.15	57	5.51	46	6.68	56
Total	50	27.70	55	25.4	51	29.6	59

subtests of the second trial administration.

An analysis of variance test was performed on the variables of age, sex, grade and size of school. In all six parts, and for each variable, there was a significant difference between mean scores. Females, older students, higher grade students and students from larger schools scored consistently better. Table 12 illustrates the mean score for each variable within each part.

Summary

The purpose of this chapter was to describe the process in which the validity and reliability of the instrument were statistically determined. The data obtained from the administration and analysis of the instrument were also reported. These data included a tabulated summary of results by age, sex, grade, size of school and previous formal nutrition education; difficulty rating; discrimination index; functioning of responses; standard error of measurement; and the six objectives of the test.

Table 12. Objective analysis by sex, age, grade and size of school.

	Objective 1; 6 items			Objective 2; 8 items			Objective 3; 8 items		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Sex									
Male	3.85	1.49	2,081	2.96	1.64	2,062	4.69	2.26	2,062
Female	4.20	1.35	2,436	3.30	1.74	2,436	5.21	1.99	2,436
Total	4.04	1.42	4,517	3.14	1.70	4,518	4.97	2.13	4,518
Age									
14	3.82	1.35	368	2.75	1.62	368	4.65	2.14	368
15	3.92	1.48	991	2.87	1.57	991	4.68	2.21	991
16	4.11	1.43	1,291	3.13	1.73	1,291	4.93	2.08	1,291
17	4.16	1.41	1,220	3.39	1.75	1,220	5.26	2.16	1,220
18	4.03	1.38	530	3.34	1.71	530	5.31	2.12	530
Total	4.04	1.42	4,400	3.15	1.71	4,400	4.98	2.11	4,400
Grade									
9	3.69	1.46	891	2.71	1.57	891	4.33	2.14	891
10	4.03	1.45	1,327	3.01	1.67	1,327	4.82	2.08	1,327
11	4.17	1.40	1,390	3.31	1.74	1,390	5.15	2.12	1,390
12	4.21	1.33	900	3.53	1.72	900	5.58	1.99	900
Total	4.04	1.42	4,508	3.15	1.71	4,508	4.98	2.13	4,508
Size									
A	3.86	1.46	523	2.89	1.68	523	4.58	2.18	523
AA	3.91	1.45	827	2.99	1.69	827	4.75	2.11	827
AAA	4.10	1.41	3,139	3.23	1.71	3,139	5.10	2.11	3,139
Total	4.04	1.42	4,489	3.15	1.70	4,489	4.97	2.13	4,489

Table 12 (continued).

	Objective 4; 8 items			Objective 5; 8 items			Objective 6; 12 items		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Sex									
Male	4.17	2.02	2,082	4.18	2.18	2,082	5.51	2.79	2,082
Female	4.92	1.79	2,436	5.33	1.93	2,436	6.68	2.53	2,436
Total	4.58	1.93	4,518	4.81	2.13	4,518	6.15	2.72	4,518
Age									
14	4.18	2.02	368	4.52	2.01	368	5.58	2.07	368
15	4.32	1.68	991	4.65	1.97	991	5.84	2.21	991
16	4.59	1.94	1,291	4.82	2.03	1,291	5.84	2.53	1,291
17	4.78	2.09	1,220	5.00	1.71	1,220	6.08	2.77	1,220
18	4.95	1.75	530	4.86	1.94	530	6.45	2.79	530
Total	4.59	1.91	4,400	4.81	1.97	4,400	6.15	2.34	4,400
Grade									
9	4.03	1.98	891	4.35	2.18	891	5.46	2.58	891
10	4.49	1.86	1,327	4.74	2.15	1,327	5.90	2.71	1,327
11	4.73	1.93	1,390	4.93	2.09	1,390	6.41	2.73	1,390
12	5.05	1.83	900	5.14	2.01	900	6.77	2.61	900
Total	4.58	1.93	4,508	4.81	2.13	4,508	6.15	2.71	4,508
Size									
A	4.47	2.07	523	4.57	2.09	523	6.03	2.56	523
AA	4.50	1.89	827	4.68	2.17	827	5.94	2.69	827
AAA	4.62	1.92	3,139	4.87	2.13	3,139	6.22	2.74	3,139
Total	4.58	1.93	4,489	4.81	2.14	4,489	6.15	2.71	4,489

V. SUMMARY, LIMITATIONS, CONCLUSIONS AND RECOMMENDATIONS

The summary of this investigation, its limitations, the conclusions derived from the major findings, and the recommendations for further research are presented in this chapter.

Summary

To fulfill the purpose of this investigation, the following procedures were taken.

1. A thorough investigation was made of high school nutrition education and related material. Consulted were a) professional journals, b) state and local high school curriculum guides, c) high school textbooks, d) recommendations of authors in health education and home economics, and e) related materials published by affiliated organizations.

2. The content to be evaluated was derived from the initial investigation. Objectives from the School Health Education Study, concept ten, levels three and four were used. A content outline was developed which reflects both the recommendations of various experts in the field and the current topics of concern.

3. A 75-item, five-option, multiple-choice test was constructed to serve as the pretrial instrument. Fifty

high school students from Crescent Valley High School, Corvallis, Oregon, were administered the test. They were asked to check the test for clarity of directions and appropriate vocabulary level. It was evident that numerous items needed simplification, and revisions were made.

4. The instrument was revised by three professors from the Foods and Nutrition department, School of Home Economics, Oregon State University, Corvallis, Oregon.

5. As a result of this committee's suggestions, the first trial instrument, consisting of 70 five-option, multiple-choice items was administered to 300 high school students in three counties in Oregon. The resulting data were analyzed for reliability and validity. Twenty items were found to be unacceptable and two items were strengthened by minor revisions.

6. The first trial instrument was submitted to a panel of experts chosen for their accomplishments in one or more of the following categories: a) actively contributing to the field of nutrition education in one of the following ways: teaching, research or publications; b) acknowledged experts in test construction and/or the evaluation process; c) members of a health-related organization, specifically those organizations concerned with nutrition education; d) medical or professional specialists who deal with problems of nutrition.

The panel of experts examined the questions using the

following criteria: a) Is the test question vague or unclearly stated? b) Is the "correct" answer scientifically sound? c) Does the test question concern information either unimportant or inappropriate for the high school student? Also the experts were asked to rate each question on a scale of one to five, with five being a very good question and one a very poor question. Only those items with a 3.00 or higher rating were retained.

7. As a result of the committee's opinions, a 50-item, five-option, multiple-choice test was administered to 4,518 students randomly selected and cluster-sampled. The resulting data were analyzed and measured to determine the a) test mean; b) standard deviation; c) difficulty rating; d) index of discrimination; e) functioning responses; f) reliability coefficient; and g) standard error of measurement.

8. The analysis of the data from the second trial administration revealed that all items functioned satisfactorily, discriminated positively, and had acceptable difficulty rating. The reliability coefficient was demonstrated acceptable by testing and statistical criteria.

9. The final form of the instrument was constructed, integrating the data received from the panel of experts and from the trial instrument. In its final form, the test had 50 items covering the scope of the six objectives from the School Health Education Study, concept ten, levels three and four.

Limitations of the Study

The study was limited to high school students in Oregon. Only multiple-choice questions in the cognitive domain were used. There was no attempt made to promote or disprove the validity of any particular nutrition education program at the high school level. The study was limited to the construction of a valid and reliable instrument for this purpose alone.

Conclusions

The purpose of this study was to construct a test to assess student achievement of selected nutrition objectives at the high school level. The following conclusions were drawn from the results of this investigation.

1. A valid and reliable instrument able to assess student achievement of selected nutritional objectives was constructed.

2. It was concluded that in Oregon secondary schools:
   a) students are lacking scientifically sound nutrition information,
   b) female students possess significantly more nutrition information than male students,
   c) students from urban schools possess significantly more nutrition information than students from rural schools, and
   d) nutrition information significantly increases with age.

Recommendations

This study was limited to the development of an instrument to measure what Oregon high school students know about nutrition.

First, conduct statewide nutrition assessments in other states. Using this instrument a comparative state-by-state study could be developed.

Second, add more objectives because this instrument used only six objectives from the School Health Education Study.

Third, develop a comprehensive curriculum covering the specific objectives. The instrument could be used as a pretest and posttest to ascertain the effectiveness of the nutrition curriculum.

Fourth, revise this instrument and revalidate it as necessary.

Fifth, study the relationship between nutrition knowledge and behavior.

Sixth, determine why the significant differences in mean scores occurred between the variables of age, grade, sex and size of schools.

Seventh, because of overall poor student performance, examine present teaching methodologies used in nutrition education.

Eighth, expand the nutrition unit in the Oregon Department of Education's Health Education curriculum.

Finally, develop a criterion-referenced nutrition education test for grades one through twelve.

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APPENDICES

APPENDIX A

OBJECTIVES SELECTED FROM THE SCHOOL HEALTH EDUCATION STUDY, CONCEPT 10, LEVELS THREE AND FOUR.

Appendix A

Objectives

Cognitive:

1. Analyzes physical, mental-emotional, social and economic factors that affect an individual's diet.
2. Interprets relationships between nutritional status and disease.
3. Assesses the interrelationships of diet, activity and other factors to the control of weight.
4. Distinguishes between food fads and fallacies and diets based on scientific principles of nutrition.
5. Examines emerging trends in society that are affecting dietary patterns.
6. Develops a plan of nutritional behaviors that promotes health for himself and his family.

APPENDIX B

PANEL OF EXPERTS

Appendix B

Panel of Experts

1. Audrey B. Champagne, Ph.D.
   Learning Research and Development Center
   University of Pittsburgh
   Pittsburgh, Pennsylvania 15261

2. Gus T. Dalis, Ed.D.
   Curriculum Specialist
   Office of the Los Angeles County
   Superintendent of Schools
   Downey, California

3. Johanna T. Dwyer, Ph.D.
   Professor, Department of Nutrition
   Harvard School of Public Health
   Boston, Massachusetts 02111

4. Frederick J. Francis, Ph.D.
   Professor and Department Head
   Department of Food Science and Nutrition
   University of Massachusetts
   Amherst, Massachusetts 01003

5. Fay Franz, Ph.D.
   Professor of Foods and Nutrition
   Brigham Young University
   Provo, Utah 84602

6. Helen Guthrie, Ph.D.
   Professor of Nutrition
   The Pennsylvania State University
   University Park, Pennsylvania 16802

7. Gail Harrison, Ph.D.
   College of Medicine
   University of Arizona
   Tucson, Arizona 85721

8. Joanne P. Ikeda, M.S.
   Nutrition Education Specialists
   9 Morgan Hall
   University of California
   Berkeley, California 94720

9. Herb Jones, H.S.D.
Department of Health Science
Ball State University
Muncie, Indiana 47304

10. Robert H. Kirk, H.S.D.
Division of Health and Safety
University of Tennessee
Knoxville, Tennesses 37916

11. Kristen McNutt, Ph.D.
National Nutrition Consortium
2121 P. St. NW, Suite 216
Washington, D.C. 20037

12. Joyce Vermearsch, Ph.D.
2443 Portage Bay Avenue
Davis, California 95616

13. Bonnie S. Worthington, Ph.D.
Professor, Department of Nutrition
University of Washington
Seattle, Washington 98195

APPENDIX C

LETTERS TO PANEL OF EXPERTS

Department of Health Oregon State University Corvallis, Oregon 97331 (503) 754-2686

Dear

I am a graduate student at Oregon State University, Corvallis in the process of completing my dissertation. I have constructed a 60-item, multiple-choice instrument which evaluates student's achievement of selected nutrition education objectives. The goal is to develop a valid and reliable instrument, which can be used by school administrators to measure the level of scientifically sound nutrition education knowledge of their high school students. The instrument is solely concerned with the cognitive domain and does not measure attitudes or behavior. My immediate task of validating the test necessitates the gathering of criticism and input from knowledgeable people.

I would like to send you a copy of the test and would certainly value your opinions or remarks. Please consider this request and respond on the enclosed post card.

Sincerely,

Glenn Darrell Passwater
19824 S.W. 68th Street
Tualatin, Oregon 97062

Department of Health Oregon State University Corvallis, Oregon 97331 (503) 754-2586

Dear

Thank you for consenting to evaluate the enclosed test designed to measure a high school student's knowledge of selected nutrition education objectives. The goal is to develop a valid and reliable instrument which can be used by school administrators to measure the level of scientifically sound nutrition education knowledge of their high school students. This would facilitate sound curriculum decisions based upon the empirical evidence of testing results.

Please consider the following criteria while evaluating each question:

1. Circle any part of the item which is vague or unclearly stated.

2. Place an "X" by the answer if you feel it is not scientifically sound.

3. Place a "U" by the item or alternative if you feel it is either unimportant or inapporpriate for the high school student.

Write in, cross out, or comment in any way you please. Enclosed you will find a stamped, addressed envelope for your convenience in returning your analysis. Your prompt reply will be greatly appreciated.

This instrument is part of a doctor's thesis being prepared under the supervision of Dr. David Phelps of Oregon State University, Corvallis.

Thank you for your cooperation.

Sincerely,

Glenn Darrell Passwater
19824 S.W. 68th Street
Tualatin, Oregon 97062

APPENDIX D

FINAL INSTRUMENT

NUTRITION QUESTIONNAIRE

Instructions:

For each question there are five possible choices. Read all of the choices before selecting the best answer. If you are not certain of an answer, select the one that seems best to you.

It is important that you:

1. do your best on each question
2. select only one answer for each question
3. choose the best answer for each question
4. answer every question on the test
5. work independently

——— ******* ———

Very Important:

In the correct spaces provided on your answer sheet, fill in:

a. your sex (under section marked SEX)

b. your grade: 9th = 1, 10th = 2, 11th = 3, 12th = 4
(under section marked MISC.1)

c. your school size: A = 1, AA = 2, AAA = 3
(under section marked MISC.2)

d. a "1", if you have been in a high school class where you have studied nutrition. If not, fill in a "2".
(under MISC.3)

e. your age: 14, 15, 16, 17, 18, 19
(under section marked SEC NUM)

f. your school code number
(under last two spaces in section marked SSN NUMBER)

g. your name is not required

Thank you and good luck

1. Teenage girls of the same height, age and diet most probably have different weights due to different:

   a. vitamin intakes
   b. activity levels
   c. daily eating times
   d. sleeping patterns
   e. eating speeds

2. Which of the following is the LEAST likely cause for a person to be underweight?

   a. poverty
   b. having parents who are thin
   c. eating snacks that are high in calories
   d. lack of appetite
   e. eating a poorly balanced diet

3. The main reason teenage boys may have large appetites is due to their:

   a. peer group influences
   b. high interest in nutrition
   c. low activity levels
   d. rapid cell growth
   e. childhood habits

4. Which of the following statements described a PHYSICAL factor which influences a person's eating pattern?

   a. eating is sometimes used to compensate for lack of love
   b. anticipating an exciting event may interfere with eating practices
   c. past experiences with foods can create a dislike for a given food
   d. some foods are associated with hot or cold weather
   e. body size and development affect the amount of food consumed

5. How should a teenager's eating habits change if she becomes pregnant?

   a. calcium and other minerals should be decreased
   b. animal fats should be eliminated from her diet
   c. there is no need to change her diet
   d. each nutrient should be increased
   e. only vitamins should be increased

6. As one grows older the number of calories the body will need to maintain its weight will decrease because:

   a. appetite decreases
   b. energy-requiring body processes slow down
   c. the body needs different nutrients
   d. calories have little effect on older adults
   e. the body has stored up all the needed calories

7. Which of the following statements about vitamins is true?

   a. food purchased from stores has insufficient vitamins
   b. vitamin pills prolong life
   c. vitamin pills taken daily help prevent colds
   d. without food, vitamin pills are ineffective
   e. the more vitamins a person takes, the better he or she will feel

8. What is the major nutritional difference between butter and vegetable margarine?

   a. butter has more calories
   b. butter has more saturated fats
   c. margarine has more minerals
   d. margarine has more vitamins
   e. margarine has more cholesterol

9. Protein in excess of what the body needs is:

   a. stored for future use
   b. changed into fat
   c. excreted in the urine
   d. changed into minerals
   e. used to fight off diseases

10. Which of the following foods contains the most calories?

   a. a medium sized apple
   b. a medium sized baked potato
   c. a carrot
   d. 8 ounces of whole milk
   e. one slice of bread

11. Which of the following statements about Vitamin C is FALSE?

   a. large doses of Vitamin C cure the common cold
   b. an excess of Vitamin C is excreted in the urine
   c. Vitamin C helps wounds to heal
   d. many fresh, raw fruits are a good source of Vitamin C
   e. a person who greatly lacks Vitamin C will bruise easily

12. Which of the following statements about food is true?

    a. organically grown food has the same amount of nutrients as commercially grown food
    b. brown eggs have more food value than white eggs
    c. grapefruit burns up excess calories
    d. raw milk has more nutrients than pasteurized milk
    e. honey has less calories than white sugar

13. Physicians consider a safe weekly weight loss for dieters to be:

    a. 1-2 pounds
    b. 3-4 pounds
    c. 5-6 pounds
    d. 7-8 pounds
    e. 9-10 pounds

14. To maintain adequate protein, a no-meat vegetarian diet must include:

    a. lecithin tablets
    b. beans, nuts and Vitamin B_{12} fortified cereals
    c. iron
    d. raw fruit, vegetables and mineral oils
    e. Vitamins A, C and D

15. These ingredients are listed in this order on the box of a certain product: wheat bran, raisins, sugar, salt and vegetable oil. Which ingredient is in the greatest amount by weight in this product?

    a. raisins
    b. vegetable oil
    c. wheat bran
    d. sugar
    e. it is impossible to tell

16. The standard term used for the amount of nutrients in nutrition labeling of foods is the:

    a. U.S. Recommended Daily Allowances (U.S. RDA)
    b. Minimum Daily Requirements (MDR)
    c. U.S. Dietary Goals (USDG)
    d. Public Health Service Guidelines (PHSG)
    e. Food and Drug Standards (FDS)

17. All of these are evidences of good nutritional practices EXCEPT:

    a. longer life spans
    b. greater work productivity
    c. delayed physical maturity
    d. greater mental alertness
    e. lower infant death rates

18. Which is NOT a U.S. Dietary Goal proposed by the Senate Nutrition Subcommittee?

    a. reduce overall fat consumption
    b. limit the intake of sodium
    c. increase consumption of refined sugars
    d. consume only as much energy (calories) as is expended
    e. reduce cholesterol consumption

19. Fortified foods have:

    a. been heated to destroy harmful bacteria
    b. been frozen to avoid spoilage
    c. been produced without harmful chemicals
    d. had protein added to resist molds
    e. had nutrients added to increase food value

20. Which of the following agencies is responsible for inspecting eating establishments and food processing plants?

    a. County Health Department
    b. Food and Nutrition Board
    c. American Dietetic Association
    d. National Research Council
    e. American Medical Association

21. Which of the following does NOT contribute to higher food costs?

    a. advertising campaigns
    b. manufacturing processes
    c. non-brand name products
    d. transportation of products
    e. food packaging

22. Which of these is NOT involved in food assistance programs?

    a. World Health Organization (WHO)
    b. United Nations Childrens' Fund (UNICEF)
    c. U.S. Department of Agriculture (USDA)
    d. Women, Infants, Children (WIC)
    e. Green Peace (GP)

23. Which of the following statements about a balanced diet is FALSE?

    a. it will probably make you feel good
    b. it contains a variety of food
    c. it guarantees a disease-free body
    d. it has enough calories to maintain body weight
    e. it includes foods from all four food groups

24. A balanced diet with all the necessary vitamins and minerals will halp prevent all of the following EXCEPT:

    a. rickets
    b. beriberi
    c. anemia
    d. colds
    e. scurvy

25. Which of the following statements about iodized salt is true?

    a. it should be taken immediately after strenuous activity
    b. it lowers the blood pressure
    c. it helps to avoid goiters
    d. it lowers the cholesterol level
    e. it helps remove water from the body

26. Which of the following minerals does NOT contribute to nutritional well-being?

    a. phosphorus
    b. iron
    c. iodine
    d. caldium
    e. lead

27. Which nutrient is of great value in producing decay-resistant teeth?

    a. sodium
    b. chlorine
    c. fluoride
    d. potassium
    e. sulfur

28. Which of the following would be LEAST effective in preventing heart disease?

    a. cut intake of saturated fats
    b. lower cholesterol levels
    c. cut down excess of calories
    d. lower sodium intake
    e. decrease Vitamin D intake

29. Lack of a nutritionally adequate diet will result in the most harm during the ages of:

    a. birth to 6 years
    b. 6-12 years
    c. 12-18 years
    d. 18-24 years
    e. over 24 years

30. A health problem that occurs from a lack of iron is:

    a. night blindness
    b. deformed joints
    c. mental retardation
    d. anemia
    e. diabetes

31. A person who eats a nutritionally blanaced diet with less calories than his or her body needs will eventually:

    a. become anemic
    b. develop vitamin deficiencies
    c. develop skin disorders
    d. become physically fit
    e. lose weight

32. Which of these statements concerning breakfast is FALSE?

    a. eating breakfast helps keep blood sugar levels up
    b. a person should skip breakfast when watching calories
    c. eating breakfast helps school performance
    d. eating breakfast with protein helps postpone mid-day hunger pangs
    e. a person who skips breakfast may have difficulty keeping a nutritionally adequate diet

33. Which of the following is the most effective and safe method for losing weight?

a. follow a current popular diet
b. skip breakfasts
c. eliminate all fats from the diet
d. eat all you want, but eliminate carbohydrates
e. eat less, exercise more and eat a balanced diet

34. The average American adult diet would benefit most from:

a. an increase in protein
b. an increase in fats
c. an increase in carbohydrates
d. a decrease in calories
e. a decrease in fiber

35. Which of these statements about weight reduction methods is FALSE?

a. appetite depressant drugs temporarily reduce appetite
b. fasting is a safe and effective method of weight reduction
c. eliminating water from the body is ineffective for permanent weight loss
d. liquid protein diets have been proven to be dangerous
e. salt-free diets are potentially hazardous

36. To gain one pound, a person would have to consume approximately how many calories over his or her energy needs?

a. 100
b. 1,000
c. 3,500
d. 5,000
e. 10,000

37. Which of the following diets would be considered the LEAST dangerous?

a. salt-free diet
b. high protein diet
c. carbohydrate-free diet
d. liquid protein diet
e. calorie restricted diet

38. An excess of calories is converted and stored in the body as:

    a. protein
    b. minerals
    c. carbohydrates
    d. fat
    e. vitamins

39. The amount of calories an average teenage girl should consume daily is approximately:

    a. under 1000
    b. 1000-1500
    c. 1500-2000
    d. 2000-2500
    e. over 2500

40. Which of the following best describes the basic four food groups?

    a. vitamins, minerals, water and fats
    b. proteins, minerals, water and fats
    c. carbohydrates, proteins minerals and water
    d. meats, fruits and vegetables, dairy products and cereals
    e. fats, starches, grains and meats

41. Which of the following best assures a balanced diet?

    a. gourmet cooking skills
    b. eating large amounts of meat
    c. eating a variety of foods
    d. eating plenty of fresh fruits
    e. eliminating fats and carbohydrates from your diet

42. The food group that is frequently enriched with iron, thiamin, riboflavin and niacin is the:

    a. milk group
    b. vegetable group
    c. fruit group
    d. meat group
    e. bread and cereal group

43. If you cannot afford to eat meat every day, a good protein substitute would be:

a. eggs
b. potatoes
c. noodles
d. oranges
e. corn

44. The nutrients used primarily for growth and repair of body tissue are:

a. starches
b. proteins
c. sugars
d. fats
e. minerals

45. Which of the following would be the poorest source of iron?

a. butter
b. eggs
c. lettuce
d. tomato juice
e. beef pot roast

46. Which of the following would NOT be a good substitute for milk in the diet?

a. peach yogurt
b. swiss cheese
c. strawberry jello
d. chocolate ice cream
e. small curd cottage cheese

47. Which of the following would be the poorest source of protein?

a. veal
b. eggs
c. fish
d. beans and nuts
e. potatoes

48. Which of the following has the LEAST amount of fats?

a. walnuts
b. hamburger
c. avacados
d. potatoes
e. peanut butter

49. Moderate daily amounts of fiber will most likely result in:

    a. brittle hair
    b. constipation
    c. strengthened fingernails
    d. diarrhea
    e. regular bowel movements

50. Cooking foods in water may decrease the amount of certain:

    a. proteins
    b. fats
    c. vitamins
    d. calories
    e. starches

PART II

This inventory helps to discover the areas of your nutrition interests. Please answer honestly. Place a letter on your answer sheet which best describes your present interest level for each of the six areas of interest.

Key to answering:

A	B	C	D	E
very interested	. . . . .	to	. . . . .	not interested

Interest Inventory:

How interested are you in knowing...

51. ...how many activities, environment, family, friends and money affect your food selection?

52. ...the difference between food facts and fallacies?

53. ...how today's food trends affect your eating habits and health?

54. ...the relationship between food and disease?

55. ...how your eating and activity patterns affect your weight?

56. ...which foods you need to maintain a healthy body?

APPENDIX E

SECOND TRIAL INSTRUMENT DATA

Table 13. Second trial administration difficulty rating (N = 4,518).

Item	Number Correct	Percent	DR	Item	Number Correct	Percent	DR
1	3,514	77.8	.78	26	3,298	73.0	.73
2	2,174	48.1	.48	27	3,496	77.4	.78
3	3,857	85.4	.85	28	2,545	56.3	.56
4	2,834	62.7	.63	29	2,390	52.9	.53
5	2,521	55.8	.56	30	2,232	49.4	.49
6	3,351	74.2	.75	31	2,712	60.0	.60
7	1,665	36.9	.37	32	3,238	71.7	.72
8	1,982	43.9	.44	33	3,593	79.5	.80
9	1,666	36.9	.37	34	2,627	58.1	.58
10	1,687	37.3	.37	35	2,733	60.5	.61
11	2,068	45.8	.46	36	1,429	31.6	.32
12	914	20.2	.20	37	2,050	45.4	.45
13	1,766	39.1	.39	38	3,309	73.2	.73
14	2,460	54.4	.54	39	1,124	24.9	.25
15	2,472	54.7	.55	40	3,559	78.8	.79
16	3,484	77.1	.77	41	2,906	64.3	.64
17	3,019	66.8	.67	42	1,600	35.4	.35
18	2,474	54.8	.55	43	3,170	70.2	.70
19	3,079	68.1	.68	44	2,659	58.9	.59
20	2,250	49.8	.50	45	1,872	41.4	.41
21	3,197	70.8	.71	46	3,158	69.9	.70
22	2,488	55.1	.55	47	2,566	56.8	.57
23	3,717	82.3	.82	48	787	17.6	.18
24	1,675	37.1	.37	49	2,122	47.0	.47
25	1,333	29.5	.30	50	2,224	49.2	.49

Table 14. Second trial, index of discrimination.

Item	Upper 27%	Lower 27%	ID	Item	Upper 27%	Lower 27%	ID
1	94	58	.36	26	95	35	.60
2	70	29	.41	27	95	45	.50
3	95	71	.24	28	86	19	.67
4	82	41	.41	29	76	28	.48
5	74	37	.37	30	70	24	.55
6	93	49	.44	31	90	22	.68
7	57	24	.33	32	92	39	.53
8	65	29	.36	33	99	42	.67
9	44	28	.16	34	83	27	.56
10	59	22	.37	35	87	26	.61
11	71	25	.46	36	43	25	.18
12	30	16	.14	37	73	16	.57
13	59	21	.38	38	97	34	.63
14	82	27	.55	39	34	19	.15
15	82	29	.53	40	99	42	.57
16	94	48	.46	41	93	31	.62
17	91	36	.55	42	57	15	.42
18	85	29	.56	43	94	39	.55
19	96	28	.68	44	83	33	.50
20	73	24	.49	45	56	24	.32
21	92	39	.53	46	95	32	.63
22	76	29	.47	47	91	20	.71
23	99	.47	.52	48	29	15	.14
24	57	.23	.34	49	83	16	.67
25	47	.22	.25	50	78	26	.52

	Index	f	Percent
1	.41 +	35	70
2	.21 to .40	10	20
3	.01 to .20	5	10
4	negative	0	0
	Total	50	100

Table 15. Second trial administration, functioning of responses.

Item	A	B	C	D	E	Item	A	B	C	D	E
1	449	3,514	391	37	123	26	374	224	447	214	3,298
2	321	740	2,174	295	986	27	166	286	3,496	315	241
3	180	219	227	3,657	225	28	315	501	380	763	2,545
4	231	665	485	287	2,834	29	2,390	700	915	192	314
5	236	663	591	2,521	490	30	666	863	368	2,232	377
6	222	3,351	539	143	256	31	337	781	330	347	2,712
7	795	219	1,258	1,665	569	32	368	3,238	296	311	289
8	1,220	1,982	237	188	887	33	256	188	262	204	3,593
9	1,037	1,666	891	455	458	34	857	344	400	2,627	277
10	183	1,458	140	1,687	1,041	35	341	2,733	618	428	382
11	2,068	575	775	308	783	36	582	1,643	1,429	525	330
12	914	571	818	1,213	987	37	524	952	578	402	2,050
13	1,766	1,805	670	171	103	38	304	324	420	3,309	141
14	175	2,460	645	577	649	39	320	1,211	1,508	1,124	344
15	283	332	2,472	538	889	40	181	242	306	3,559	218
16	3,484	406	229	187	210	41	159	300	2,906	543	598
17	229	342	3,019	319	598	42	790	732	411	960	1,600
18	284	617	2,474	655	473	43	3,170	540	379	217	205
19	304	306	468	357	3,079	44	285	2,659	347	318	898
20	2,250	1,226	430	394	207	45	1,872	446	1,455	380	342
21	478	294	3,197	292	247	46	231	260	3,158	698	151
22	189	615	475	747	2,488	47	469	443	342	666	2,566
23	160	271	3,717	221	139	48	1,367	336	1,641	787	352
24	626	844	972	1,675	377	49	338	542	960	469	2,122
25	639	695	1,333	524	1,304	50	609	661	2,224	364	625

Note: The correct response is underlined for each item in the above table.

Table 16. Second trial administration, standardization conversions (N = 4,518).

Raw Score	Z	T	Percentile	Frequency	Cumulative Frequency
1	-2.86	21	.19	1	1
2	-2.75	22	.35	0	1
3	-2.64	24	.47	0	1
4	-2.54	25	.62	1	2
5	-2.43	26	.82	2	4
6	-2.32	27	1.07	8	12
7	-2.22	28	1.39	18	30
8	-2.11	29	1.79	27	57
9	-2.00	30	2.28	50	107
10	-1.89	31	2.87	50	157
11	-1.79	32	3.59	70	227
12	-1.68	33	4.46	84	311
13	-1.57	34	6.68	102	413
14	-1.47	35	8.08	100	513
15	-1.36	36	9.68	103	616
16	-1.25	37	11.51	106	722
17	-1.14	38	13.57	107	829
18	-1.04	39	15.87	97	926
19	-0.93	41	18.41	104	1,030
20	-0.82	42	21.19	107	1,137
21	-0.72	43	24.20	97	1,234
22	-0.61	44	27.43	114	1,348
23	-0.50	45	30.85	122	1,470
24	-0.39	46	34.46	137	1,607
25	-0.29	47	38.21	129	1,736
26	-0.18	48	42.07	125	1,861
27	-0.07	49	40.02	163	2,024
28	0.03	50	50.04	154	2,178
29	0.14	51	53.98	191	2,369
30	0.25	53	57.43	169	2,538

Table 16 (continued).

Raw Score	Z	T	Percentile	Frequency	Cumulative Frequency
31	0.36	54	61.79	183	2,721
32	0.46	55	65.54	199	2,920
33	0.57	56	69.15	188	3,108
34	0.68	57	72.57	161	3,269
35	0.78	58	78.80	176	3,445
36	0.89	59	81.59	193	3,638
37	1.00	60	84.13	176	3,814
38	1.11	61	86.43	142	3,956
39	1.21	62	88.49	127	4,083
40	1.32	63	90.32	132	4,215
41	1.43	64	91.92	104	4,319
42	1.53	65	93.82	78	4,396
43	1.64	66	94.52	53	4,450
44	1.75	67	95.54	34	4,484
45	1.86	68	96.41	25	4,509
46	1.96	69	97.13	5	4,514
47	2.07	70	98.61	2	4,516
48	2.18	71	98.61	1	4,517
49	2.28	72	98.93	1	4,518
50	2.38	73	99.18	0	4,518

Mean: 27.677

Standard Deviation: 9.333

Table 17. Second trial instrument, participating schools and their corresponding scores.

School	N	$\bar{X}$	Std. Dev.	School	N	$\bar{X}$	Std. Dev.
1	30	26.96	7.68	41	144	31.33	8.82
2	144	25.11	9.06	42	201	24.05	10.00
3	228	24.42	9.41	43	71	24.71	9.30
4	63	27.57	8.93	44	96	27.59	9.38
5	139	29.58	9.62	45	53	28.13	8.03
6	62	31.27	7.44	46	34	22.50	9.57
7	--	--	--	47	32	27.15	9.61
8	102	23.17	9.93	48	--	--	--
9	26	26.15	8.94	49	74	28.82	9.03
10	61	30.60	8.20	50	37	23.78	8.71
11	86	22.50	9.99	51	17	19.70	7.09
12	48	30.45	7.20	52	17	33.52	6.83
13	150	31.82	7.88	53	31	30.77	7.16
14	67	28.38	7.87	54	--	--	--
15	--	--	--	55	--	--	--
16	35	25.08	11.79	56	56	25.23	9.39
17	66	30.48	7.39	57	40	24.42	10.05
18	150	31.06	7.79	58	23	27.56	9.53
19	12	27.33	9.65	59	215	29.36	9.01
20	77	26.05	8.50	60	163	30.22	8.27
21	--	--	--	61	205	28.73	8.45
22	--	--	--	62	69	27.10	9.82
23	113	23.31	8.44	63	16	26.18	10.03
24	21	24.71	9.72	64	15	26.66	5.21
25	47	27.17	9.67	65	105	29.74	9.97
26	57	31.91	9.23	66	70	26.40	9.92
27	83	28.85	8.53	67	98	22.25	8.78
28	61	23.34	9.80	68	92	32.42	7.24
29	82	27.58	8.00	69	126	28.95	8.07
30	15	28.53	9.75	70	--	--	--
31	--	--	--	71	58	32.63	9.03
32	--	--	--	72	--	--	--
33	38	27.28	11.07	73	56	26.66	10.58
34	52	27.98	7.85				
35	--	--	--	Total	4518		
36	66	30.40	8.09				
37	--	--	--				
38	12	28.82	8.49				
39	59	30.01	8.77				
40	15	22.80	9.90				

APPENDIX F

PARTICIPATING HIGH SCHOOLS

APPENDIX F

PARTICIPATING HIGH SCHOOLS

Bend
Brookings
Burnt River
Canby
Cascade Union

Central
Cottage Grove
Crook
Culver
David Douglas

Dayville
Detroit
Eagle Point
Eddyville
Elgin

Elkton
Forrest Grove
Gladstone
Glide
Grant Union

Harper
Hermiston
Hillsboro
Illinois Valley
Jackson

Lake Oswego
Lakeview
Marshfield
McKenzie

McMinnville
McNary
Monroe
Newburg
North Eugene

Pacific
Paisley
Perrydale
Powder Valley
Powers

Redmond
Roosevelt
Roseburg
Scio
Seaside

Silverton
South Albany
Springfield
Stanfield
Sweet Home

Thurston
Ukiah
Wahtonka
Wasco
Weston-McEwen

West Linn
Winston-Churchill
Woodburn
Yamhill-Carlton

APPENDIX G

LETTERS TO SCHOOL ADMINISTRATORS AND TEACHERS

SUPERINTENDENT OF PUBLIC INSTRUCTION
[redacted]
SALEM, OREGON 97310

March 26, 1979

Mr. Maitland Goodman, Supt./Principal
Paisley School District 11C
Box 97
Paisley, OR 97636

Dear Maitland:

We are concerned about the health of our youth due to the lack of nutrition information and poor nutritional habits. The Department of Education is interested in knowing how much nutrition information our high school students have acquired.

Mr. Darrell Passwater, a doctoral student at Oregon State University, is working on a study which will provide the information we would like. He will be sending you a letter asking permission to contact your health education teacher about administering a 50-question test concerning nutrition. I encourage you to respond positively to his request.

Thank you for your cooperation. If you have any questions, please contact Len Tritsch our Specialist in Health Education at 1-800-452-7813, Extension 3602.

Cordially,

Redacted for Privacy

Verne A. Duncan
State Superintendent of
Public Instruction

VAD:jh

March 15, 1979

Dear Administrator,

I am a graduate student at Oregon State University in the process of completing my dissertation. I have constructed a 50-item, multiple-choice test which evaluates student's achievement of selected nutrition education objectives. The goal is to develop a valid and reliable test, which can be used by school administrators to measure the level of scientifically sound nutrition knowledge of their high school students. The study is solely concerned with the cognitive domain and does not measure attitudes or behavior.

The test has been analyzed by twenty nationwide nutrition experts, pretested in three high schools and approved by the Oregon State Department of Education. The immediate task of validation necessitates a statewide sample pretesting. Your school was one of seventy-eight schools selected for participation.

All tests, instructions and answer sheets are provided by the State Department of Education. Since the study best profits by a sampling of students from different subjects, the questionnaire is not limited to the health or home economics classes. It has also been designed to be completed in just one class period. Test results from your school will be tabulated and sent to your school only.

If you agree to participate in this study, please return the enclosed information sheet in the stamped envelope. If you have any questions contact me at Oregon State University (754-2686) or Len Tritsch at the Oregon Department of Education (378-3602).

Thank you for your cooperation.

Sincerely,

Redacted for Privacy

Glenn Darrell Passwater
19824 S. W. 68th Street
Tualatin, Oregon 97062

Dear Teachers,

Thank you for your cooperation in this study designed to assess Oregon high school students' nutritional knowledge. In administering the questionnaire, please follow these basic instructions:

a. Each student must use a #2 pencil. Lines must be neat and fully darkened.

b. It is very important that the student instruction sheet be read orally. (To avoid classroom confusion, read instructions ahead of time and locate the various answer sections on the answer sheet.) The computer will reject any incomplete answer sheets.

c. Your school size is determined by your sports rating of A, AA or AAA.

d. Your school code number is _____.

e. If, in your opinion, a student is not attempting to answer the questions to the best of his/her ability, please mark an X on the answer sheet next to the space marked SEX.

There are 50 questions in Part I. Part II consists of an interest inventory of six items. If the students are diligent in their work they should finish by the end of class. Please encourage a studious atmosphere.

The study would best profit by sampling students from different subjects. And so, if possible, do not limit this questionnaire to the health or home economics classes. _____ tests and _____ answer sheets have been supplied for this testing. A minimum of _____ students should take the test during the week of

Please return all tests and answer sheets in the stamped, addressed envelope. Test results from your school will be tabulated and sent to your school only.

Thank you for your cooperation.

Sincerely,