INSTRUCTING DIETITIANS IN THE METRIC

SYSTEM OF MEASUREMENT

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Home economists have been known as agents of change and this was evidenced when they passed a resolution supporting conversion to the metric system in 1967. The American Dietetics Association, a specialty area of home economics, also passed a resolution supporting metric conversion. This requires extensive education about the metric system at all levels of the educational system. The author is very grateful to the 68 dietitians who assisted in this study of two teaching strategies for providing knowledge of the metric system to dietitians.

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CHAPTER I

INTRODUCTION

The question was no longer, "Will America go metric?" Nor was the question, "When will America go metric?" The big question was, "How will the conversion be carried out?" One of the main problems in conversion was one of educating the public. Those reponsible for educational policies and procedures had to determine the best method or methods of teaching the metric system to Americans.

The United States was the last major industrial nation to convert to the metric system of measurement. More than 90 percent of the world's population used metric measurement in everyday living. The metric system of measurement was much simpler to use than the English system, but more importantly it allowed us to communicate with the rest of the world.

The "Metric Conversion Act of 1975", signed by President Gerald Ford on December 23, 1975, established a national policy of coordinating the increasing use of the metric system in the United States and established a United States Metric Board to coordinate the voluntary conversion to the metric system. The metric board had as one of its functions to devise and carry out a broad program of planning, coordination and education of the public consistent with other national policies and interests (American Metric Journal, 1976).

It was expected that by 1980 Americans would be using metric measurement a great deal and by 1985 the United States would probably be completely converted to the metric system. Metrication in the United States meant that all people learn a new system of measurement. One of the biggest problems in metric conversion was motivating people to change. Before people will change, they must see a need for the change. Hunderson and Glunn (1975) believed this required an affective value change that would not come automatically. They anticipated great energy would be needed to move a naturally lethargic populace into the unfamiliar metric world of measurement.

Many of the problems associated with the change were educational and the stimulus for change had to come from the educational community. Institutions had the major responsibility of educating people in the use of the metric language. This presented a major challenge to all of our educational institutions (Hunderson and Glunn, 1975). Educational associations and professional groups exerted a positive and sometimes a major force for metrication. The extent of their support and the roles played by particular specialties within education varied widely. The associations of science and mathematics educators were usually in the forefront followed by support from industrial and vocational educators (Morehouse and Schoonmaker, 1975). In 1967 the American Home Economics Association passed a resolution that promoted the adoption of the metric system. One of the specialty areas of Home Economics, The American Dietetics Association, also passed a motion at the House of Delegates meeting in October, 1975, stating:

> The American Dietetics Association would actively work toward adoption of metrication in the United States through encouraging the use of metric units on food labels, in nutrition education materials, sponsoring continuing education for members, and to join the American Home Economics Association in their efforts to teach homemakers how to purchase foods for

their families using the metric units (American Dietetics Association, 1975-76, p. 12).

Significance of the Study

University-industry workshops had been held in different states, but were mainly to discuss the metric system's potential benefits and possible routes for its introduction. A positive educational program was needed for all segments of society. Young children find the metric system easier to learn than adults because they have no concepts about measurement to discard. Chalupsky and Crawford (1975) reported that participants have only judged and not tested the effectiveness of metric teaching strategies. Their judgments were based on consensus and were plausible. There was need for experimentally validated evidence to fill the canons of behavioral science. Very little acceptable research evaluating metric teaching was found and this indicated a need for carefully designed and controlled studies evaluating metric teaching strategies.

Many professional persons did not have the time, funds and the ability (could not leave their family and position responsibilities) to attend workshops or classes devoted to teaching the metric system. Further, there were professional persons who were affected more by the adoption of the metric system. These professional people needed alternative ways of being able to learn about the metric system.

Registered dietitians were persons faced with this problem. The focus of this research effort was to test alternative methods--programmed instruction and traditional lecture--of learning the metric system of measurement.

Target Population of the Study

The major purpose of this study was to develop two instructional strategies concerning information about the metric system for use with professionally employed registered dietitians in the state of Oklahoma. The state of Oklahoma had approximately 300 dietitians and approximately 240 of the 300 were registered dietitians.

The American Dietetics Association established definitions for use in the dietetics profession. The registered dietitians had successfully completed the examination for registration and maintained continuing education requirements of the dietetics profession. All participants of the study were involved in nutritional care by participation in food service management, extending knowledge of food and nutritional principles, in teaching principles of application or dietary counseling.

This study was experimental and the sample was divided into three groups. Group I was exposed to the traditional lecture method of instruction; Group II used the programmed instruction; and Group III was the control group with no instruction. The major objective of this study was to find an effective strategy for teaching dietitians basic knowledge of the metric system of measurement.

The selection of this population was done because the writer was a student at Oklahoma State University and the qualifications for registered dietitians were the same in all states. The American Home Economics Association and the American Dietetics Association had both acknowledged professional responsibilities in helping the nation convert to the metric system of measurement.

Statement of Purposes and Objectives

The Metric Conversion Act of 1975 declared a national policy of coordinating the increasing use of the metric system in the United States. In the near future all Americans will need to have an understanding of the metric system of measurement. The purpose of this study was to develop and test the effectiveness of two teaching strategies, programmed instruction and the traditional lecture method of instruction, for use with registered dietitians in developing a basic knowledge of the metric system of measurement. The main objectives of this study were:

1. To determine which of the two teaching strategies best provided dietitians with a basic knowledge of the metric system of measurement.
2. To determine what variables were associated with comprehension of the metric system of measurement by professionally employed, registered dietitians.

Hypotheses

The null hypotheses to be tested were:

Hypothesis I (H_1): There will be no significant difference in the pretest scores (Metric Skills I) of dietitians receiving the traditional lecture method of instruction, those using programmed instructional materials, and those of the control group.

Hypothesis II (H_2): There will be no significant difference in the post-test scores (Metric Skills II) of dietitians receiving the traditional lecture method of instruction, those using programmed materials, and those of the control group.

Hypothesis III (H_3): There will be no significant difference in the nine section scores of the pretest (Metric Skills I) by dietitians receiving the traditional lecture method of instruction, those using programmed materials, and those of the control group.

Hypothesis IV (H_4): There will be no significant difference in the nine sections of the post-test (Metric Skills II) of dietitians receiving the traditional lecture method of instruction, those using programmed materials, and those of the control group.

Hypothesis V (H_5): There will be no significant relationship in comprehension of the metric system by dietitians and years of membership in ADA.

Hypothesis VI (H_6): There will be no significant relationship in comprehension of the metric system by dietitians and the number of professional meetings and/or continuing education classes attended.

Hypothesis VII (H_7): There will be no significant difference in comprehension of the metric system by dietitians and the type of professional position held.

Hypothesis VIII (H_8): There will be no significant difference in comprehension of the metric system by dietitians and the route (internship, traineeship, degree, experience) used to attain ADA membership.

Hypothesis IX (H_9): There will be no significant difference in comprehension of the metric system and the highest degree held by the participant.

Hypothesis X (H_{10}): There will be no significant relationship in comprehension of the metric system by dietitians and the participants undergraduate grade-point-average.

Hypothesis XI (H_{11}): There will be no significant relationship in comprehension of the metric system by dietitians who favor, those who oppose, and those who are undecided about metric conversion.

Hypothesis XII (H_{12}): There will be no significant relationship in comprehension of the metric system by dietitians who have a workable knowledge of the metric system and those who do not have a workable knowledge.

Hypothesis XIII (H_{13}): There will be no significant difference in comprehension of the metric system by dietitians and how the participants acquired a workable knowledge of the metric system.

Hypothesis XIV (H_{14}): There will be no significant difference in comprehension of the metric system by dietitians and the method of instruction preferred by the participants for learning the metric system.

Hypothesis XV (H_{15}): There will be no significant relationship in comprehension of the metric system by dietitians and owning or having available metric measuring equipment for use and not having metric measuring equipment for use.

Hypothesis XVI (H_{16}): There will be no significant relationship in comprehension of the metric system by dietitians and the number of metric measures they have available for use.

Hypothesis XVII (H_{17}): There will be no significant difference in comprehension of the metric system and if the participants often use, sometimes use, or never use metric measures.

Assumptions

The following assumptions were basic to this study:

1. The effectiveness of instruction was determined by instructor-made pre- and post-tests and the scores were an indication of achievement.
2. Findings could serve as a basis for determining strategies for teaching metric information to dietitians.
3. The three participating groups had similar professional qualifications because similar qualifications were required to become registered dietitians.

Limitations

The following limitations were acknowledged by the researcher:

1. The study was limited to professionally employed, registered dietitians in the state of Oklahoma.
2. All participants willingly participated in the study.
3. All participants followed instructions completing the instruments (questionnaire, pretest, and post-test).
4. The development and evaluation of two teaching strategies for identifying comprehension of the metric system.
5. A limited period of time thus making it necessary to restrict the research problem to short term growth measurement.
6. The sample was self-selected rather than by a random sampling procedure.

Definition of Terms

The following definitions will explain how certain terms will be used in this study.

<u>Achievement</u>--A measure of the student's mastery of the materials of the course (Hoover, 1976).

<u>American Dietetics Association (ADA)</u>--A professional organization responsible for establishing educational and supervised clinical experience requirements and standards of practice in dietetics (<u>Journal of American Dietetics Association</u>, 1975).

<u>Criterion Instrument</u>--Measures the extent to which a desired kind of competence, proficiency or capability has been achieved (Espich and Williams, 1967).

<u>Dietitian, ADA</u>--A specialist educated for a profession responsible for the nutritional care of individuals and groups. This care includes the application of the science and art of human nutrition in helping people select and obtain food for the primary purpose of nourishing their bodies in health or disease throughout the life cycle (<u>Journal of American Dietetics Association</u>, 1975).

<u>Dietitian, Registered</u>--An ADA dietitian who has successfully completed the examination for registration and maintains continuing education requirements. The participation in nutritional care may be in single or combined functions: in foodservice systems management; in extending knowledge of food and nutrition principles; in teaching these principles for application according to particular situations; or in dietary counseling (<u>Journal of American Dietetics Association</u>, 1975).

<u>Feedback</u>--Knowledge of results as to whether the answer or choice is correct or incorrect (Markle, 1964).

<u>Field Test</u>--Is testing the program on the population and under the conditions for which it is designed. The objectives will be to determine

how well the program accomplishes its purpose and to validate the program (Espich and Williams, 1967).

Frame--A unit of the program that requires a response from the student (Espich and Williams, 1967).

Learning--A process which enables the living organisms to modify their behavior fairly rapidly in a more or less permanent way, so that the same modification does not have to occur again and again (Gagne, 1974).

Lecture--Is a teaching approach in which the instructor presents the material and conducts discussion (Webster's Dictionary, 1959). The lecture can effectively present new information and the discussion gives students the opportunity to analyze, find relationships, and develop generalizations. The student can begin developing skill in critical thinking (McKeachie, 1963).

Linear Program--A program devised to advance the student step-by-step to his learning goal and so organized that he will make minimal errors (Garner, 1966).

Metric System--Was developed during the eighteenth century by scientists in France. It is based primarily on the meter, a length defined as one ten-millionth of the distance from the North Pole to the equator. The metric system progresses logically in the units of ten and prefixes have the same meaning whether measuring length, area of liquid volume or mass. The basic units as well as prefixes are consistent (Phillips, 1972).

Pretest--Is an examination instrument administered to the subjects before the material is introduced.

Post-Test--Is an evaluation instrument given to the subject after instruction has been completed.

Self-Pace--The movement, the progress or development set by an individual for himself (Markle, 1964).

Organization of the Study

This study was organized into four chapters. Chapter I presented a description and statement of the problem, significance of the study, statement of purposes and objectives, hypotheses, assumptions, limitations of the study, target population, definition of terms, and organization of the study.

Chapter II was a review of literature related to the study. The researcher did not find metric studies that were done with home economics as the target population. The profession launched extensive education programs on metrication so that conversion was as efficient and painless as possible.

Chapter III presented the procedure used in developing the materials and conducting the study. Selected components of programmed instruction in the metric study were developed. The linear mode in the textbook format was used. The same selected components of metric education were utilized in the traditional lecture method. Registered dietitians that were professionally employed became the basis for the comparison of methods. A questionnaire and pretest were administered to all participants prior to administration of the program. Immediately on completion of the programs a post-test was given to determine the gain scores of the participants.

Chapter IV presented the findings, conclusions and recommendations of the study.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The studies which follow were chosen for inclusion in this chapter because of their close relationship to the problems. In order to establish relevance, the research was grouped into nine categories:

1. History of the metric system.
2. Reasons for converting to the metric system.
3. The metric system defined.
4. Advantages and disadvantages of metric.
5. Metric and the home economist.
6. Metric and education.
7. Teaching the metric system.
8. Programmed instruction as a teaching device.
9. Programmed instruction in home economics.

A computer search was done to locate meaningful studies. Sources included in this search were books, periodicals, journals, dissertations, pamphlets, and unpublished research reports.

History of the Metric System

The idea that weights and measures were among the earliest devices invented by mankind was generally conceded by historians of metrology who based their conclusions on the fact that archaeological records of the most ancient civilizations exhibit well-developed concepts of weighing and measuring. A need for uniform weights and measures existed in any country where people traded with each other or with other countries. A need for uniform weights and measures was created in the United States as commerce developed between the 13 colonies. This need led to clauses in the Articles of Confederation and the Constitution of the United States giving power to Congress to fix uniform standards of weights and measures (Hopkins, 1974). This was the beginning of serious deliberations with regard to fixing a standard of weights and measures in the United States.

The creation of the metric system by France and the beginning of debates in the United States, with regard to fixing a standard of weights and measures, both occurred in the year 1790. Thomas Jefferson, secretary of state, was assigned by President Washington in 1790 to prepare a new system of weights and measures for Congress to consider to replace the English system that was being used. Jefferson devised a complete, consistent wholly decimal system of weights and measures and presented them to Congress, but Congress took no action. His system coincided with the French system in the direct relations of linear, weight, and units of volume and the use of simple decimal arithmetic (Hopkins, 1974; Schimizzi, 1975).

In 1816, John Quincy Adams, secretary of state, was instructed to study again the possibility of adopting a national, standardized system of weights and measures. Adams reported on five advantages of the metric system and they were:

1. The "invariable" standard of length taken from nature.

2. The single unit for weight and the single unit for volume.

3. The decimal basis.

4. The relation of weight units to French coinage.

5. The uniform and precise terminology.

Even though he was convinced of the merits of the metric system, he was reluctant to recommend the immediate conversion to metric because most of the nation's trade was with the nonmetric British Empire. Again Congress took no action, but the debate concerning the adoption of a standard for weights and measures, continued with varying degrees of intensity for the next 50 years. Then in 1866, Congress made the use of the metric system legal (Schimizzi, 1975; Hopkins, 1974).

The next major development was in 1875 when the Treaty of the Meter was signed in Paris by 17 nations and the United States was one of those 17 nations. The treaty provided for the fabrication of new and improved standards of metric weights and measures, the establishment and maintenance of a permanent International Bureau of Weights and Measures, and a creation of a general conference as a permanent deliberative body to pass upon international weights and measures matters. Final United States approval of the treaty was granted in 1878 when it was signed by President Hayes (Hopkins, 1974; Bright and Jones, 1973).

The next major step in the United States was Congress establishing the National Bureau of Standards in 1901. Their first meeting was held at Washington, D. C., in 1905 with the objective of securing uniform laws of weights and measures (Hopkins, 1974). The debate in the United States continued and the American Home Economics Association watched closely all changes that led the United States closer to metrication. In 1967, AHEA decided it was time to act and passed a resolution supporting the adoption of the metric system. Doris Hanson, executive director of AHEA said, "Many citizens care deeply about our world position and want us to be part of the family of man. To be in step with the language of measurement is a step in that direction" (Gaucher and Perry, 1974, p. 14).

Gradually all other industrialized nations had adopted plans for converting to the metric system. This created a great concern in the United States and in 1968 President Lyndon Johnson signed into law an act providing for a three-year program to determine the impact of increasing use of the metric system in the United States. The results of this study were submitted to Congress in 1971. The Secretary of Commerce recommended to Congress that the United States change to a predominant use of the metric system through a coordinated national program (Bright and Jones, 1973). Debate continued with little action until December 23, 1975, and President Gerald Ford signed the Voluntary Metric System bill, which outlined a 10-year plan for voluntary transition to the metric system (American Metric Journal, 1976).

The success of the conversion program depended mainly on those responsible for carrying it out and in the United States this was management in all fields of private and public endeavor. Lewis Branscomb, former head of the National Bureau of Standards, believed that going metric was not really something the federal government could do for the country. People and companies had to make changes themselves, at their own pace, and in their own way. During the changeover to metric, four basic principles were followed and they were:

1. The rule of reason--changes to metric were made where it was advantageous to do so.

2. Costs lie where they fall--this helped assure that the costs were reasonable and commensurate with benefits.
3. Voluntary changeover--the changeover was not mandatory.
4. Non-government initiative--initiative and planning rested in the hands of the private sector (Groner and Boehm, 1973; Barbrou, 1974; Batcher, 1975).

The legislation passed in 1975 conveyed to the whole country the knowledge that increasing metric usage was considered to be in the best interest of our country and was in accord with our national policy. Our educational systems were alerted to the need of teaching our youngsters the metric system to prepare them for their future place in the business world. We know that conversion to the metric system involved complex social and technological changes and exerted a large impact upon American education.

Reasons for Converting to the Metric System

Many people questioned the necessity of converting to the metric system if it was expensive and created so many problems. The United States was in a unique position in metric conversion. Unlike most events in our recent history, we were behind every other major country in converting to metric. We were the last industrial nation to commit ourselves to adoption of the metric system. It was estimated that about 90 percent of the earth's population used parts of the metric system of measurement. Many traditional United States export markets were legislating against non-metric units. If we were to increase our exports of manufactured products to help our balance of trade then converting to the metric system was a must (Schimizzi, 1975; Chalupsky and Crawford, 1975).

Another reason for converting to the metric system was to influence the making of international standards. The American National Standards Institute (ANSI), an organization supported by business and industry, represented the United States at the International Standards Organization (ISO) and the International Electrotechnical Commission (ETC). The ANSI delegates had difficulty getting their views accepted because of our national standards. Just a small fraction of the metric standards had been written and approved and approximately 10,000 metric standards remained to be written and approved. There was still time for the United States to help write these standards to favor American industry. Also, we helped develop the worldwide engineering standards that were based on the metric system (Bright and Jones, 1973; Hopkins, 1974; Groner and Boehm, 1973).

As stated previously, industry took the initiative in converting to the metric system. In 1972, multinational companies such as Caterpillar Tractor, Deere and Company, Ford Motor, General Motors, Honeywell, IBM, and International Harvester announced plans to begin metric conversion. These companies gradually converted so the changeover was less expensive. For example, IBM had a thoroughly planned and executed company program and by 1978 all new product designs conformed to metric standards. The first automobile produced in the United States to have metric content was the Pinto by Ford. Other companies followed these examples to avoid the inefficiency and inconvenience in operations of United States plants at home and abroad by manufacturing the same products to different standards (Groner and Boehm, 1973; Chapulsky and Crawford, 1975).

The Metric System Defined

What was the metric system and why was it better than our present system of weights and measures? It was a permanent, accurate, universally understood system of standards. All units in the metric system were related by the number 10. The metric system bridged the gap between measurement and computation. The modernized version of the metric system was the International Sytem of Units (SI) established by international agreement to provide a logical and interconnected framework for all measurement in science, industry, and commerce.

Roberts (1974) explained the SI system was built upon a foundation of six base units of measurement. These units were presented in Table I.

TABLE I

BASE UNITS OF MEASUREMENT

Quantity	SI Symbol	Unit
Meter	m	Length
Kilogram	kg	Mass
Seconds	s	Time
Ampere	a	Electric Current
Kelvin	k	Temperature
Candela	cd	Luminous Intensity

The four areas that concerned us most were weight, length, volume, and temperature. Each physical quantity had its own unit of measurement. The basic metric measurement of length was the meter; for weight, it was the gram; and the liter was for volume. The prefixes used for weight, length, and volume were not used for temperature. The metric measurement of temperature was the degree Celsius and it was derived from the Kelvin scale. Temperature was written as °C or spoken of as "degrees Celsius".

There were three common metric prefixes for division of 10 and three common prefixes for multiples of 10. These were shown in Table II.

TABLE II

METRIC PREFIXES

Multiples and Submultiples		Prefix	SI Symbol
	$1000 = 10^3$	kilo	k
	$100 = 10^2$	hecto	h
	$10 = 10^1$	deka	da
Base Unit	$1 = 10^0$		
	$0.1 = 10^{-1}$	deci	d
	$0.01 = 10^{-2}$	centi	c
	$0.001 = 10^{-3}$	milli	m

Americans needed to be aware of some rules and recommendations for writing metric units. One convention unfamiliar to many Americans was that three-digit groups were separated by a space rather than a comma. Also, it was suggested that we drop the raised dot as a symbol of multiplication because some countries used this as a decimal point. Another guideline was not to leave a space between symbols but a space was left between the numeral and the symbol, so no period was used unless it was the end of the sentence. Another guideline was to have a zero proceed numbers that were less than one. These guidelines helped to develop a feel for metric for everyday use (Schimizzi, 1975; Roberts, 1974).

Advantages and Disadvantages of Metric

The more knowledgeable a person was about metric, the more receptive they were to change. People familiar with the metric system believed that the greatest obstacle to overcome was human resistance to change. Learning, unlearning, and relearning was always a large undertaking, but on the national scale it was momentous. The metric system offered several advantages that helped overcome the resistance to change. Oppert (1974) identified the following advantages of the metric system:

1. When the metric system was adopted, many students did not have to develop a high degree of competence in the manipulation of fractions.
2. A common measurement language reduced barriers between scientists, engineers, and industrial workers in our country and abroad. It saved time and errors.
3. A change in our measurement system provided the opportunity to eliminate the superabundance of varieties in sizes of products,

parts and containers, product design, etc.

4. We were out of step with the rest of the world with our customary system of measurement.

5. The metric system contained units for measuring very small quantities with precision.

6. The metric system coordinated the measures of length, area, volume, and mass and this facilitated computation. The system of prefixes and decimalization made it easy to change from one unit to another.

The arguments against the conversion to metric have changed little in almost 200 years. Some of the reasons that people have given for opposing change were:

1. The high cost of conversion.

2. People resist change.

3. Metric units were too large or too small for very young children to handle easily.

4. Our customary units of measure were closely related to the human anatomy.

5. Our present system had multiples which were based on powers of 2 and 12. Twelve was divisible by 2, 3, 4, and 6 and that was twice the number of divisors of 10 (Oppert, 1974).

Suggested solutions for the problem of metric changeover varied as much as our teaching methods. Warning (1972) reported a survey that was done at the University of Michigan and of those surveyed 46 percent thought television the best method for educating the public about the metric system. Fifty percent of this same group said they would attend a course to learn the new system of measures, but 34 percent said they would not. This survey indicated every means available was needed to educate the public. According to research at Iowa State University, people advance through five stages before they use a new product or system with the ease of habit.

The five stages for converting to the metric system were:

1. Learning to think metric or awareness stage. This began when a person heard we were going to convert to the metric system.
2. Information gathering stage or when the person asked questions and perhaps acquired some inexpensive metric tools.
3. Application stage or when the person applied his knowledge.
4. Trial stage or using the metric system more and more and almost forgetting the old system.
5. Adoption stage or when you became a metric enthusiast (Warning, 1972).

Metric and the Home Economist

We have learned from other countries that people learn the metric system much faster if they use the metric system rather than using the old system and converting. As agents of change, home economists have launched extensive and intensive educational programs on metrication. Gaucher and Perry (1974) saw the roles of the home economists in metric conversion as:

1. A primary role in interpreting and teaching the new measuring system as it related to food preparation and to the purchasing of food, home equipment, furnishings, fabrics, and various items for sewing.

2. Playing an important role in assuring students and parents that a switch to the metric system did not make every measuring device, cake pan, sewing machine, range, thermometer, scale, and cookbook immediately obsolete.

3. She was called upon to establish an "accommodation" between the two systems until metric was a total way of life.

In converting to the metric system, we had two types of conversion. The first type was "soft" conversion or changing measurement language. Soft conversion was simply a matter of translation and was relatively painless. When we progressed to hard conversion then crucial problems arose and effected everyone to some extent. Then food was bought by kilograms, parts used in manufacturing were specified in millimeters and centimeters, and building codes were revised to accommodate materials that were available in metric. As home economists, we were the change agents and educators for a nation of consumers as the change to metric occurred (Batcher and Young, 1974).

The area of home economics that probably generated the most discussion during the change to metric was the area of food and nutrition. AHEA sponsored a task force within the American National Standards Commission Z61 to work on standards for metrication of utensils beginning with measurements and measuring devices (Gaucher and Perry, 1974). Homemakers found that measurements for length, volume, weight, and temperature changed and calories were changed to joules. Many containers had dual weights and measures, but eventually only metric units appeared. In the area of clothing and textiles, most of the changes were in terminology or soft conversion. This was an ideal time to standardize sizes. Also in the area of housing and equipment most of the changes were in terminology, so we did not discard old equipment.

Metric and Education

Extensive education about the metric system was done at all levels of our educational system. Australia believed that the progress of their conversion was largely due to their massive educational campaigns. The Education Amendments of 1974 specified that increased use of the metric system in the United States was inevitable and metric became our dominant system of weights and measures. It was the policy of the United States to encourage educational agencies and institutions to prepare our students to use the metric system of measurement with ease and facility as a part of the regular education process (Chalupsky and Crawford, 1975). Also, the National Education Association endorsed a carefully planned, concerted effort to convert to the metric system. The National Education Association believed this was essential for the future of American industrial and technological development and to the evaluation of effective world communications (Schimizzi, 1975). Industry took the initiative in converting to the metric system, but educating the public presented us with a serious challenge. The U. S. Office of Education funded projects that were designed to help with conversion problems.

One of the projects funded by the U. S. Office of Education was for the development of a National Metric Education Center at Western Michigan University. The center analyzed difficulties encountered in converting the present system of measurement in the United States to the metric system. The project was aimed at preparing teachers to train others in teaching the metric system and the use of equipment geared to metric measure. The funding was for 1973 to 1976 and the first year was spent recommending changes in teacher education programs and developing appropriate instructional materials. The second and third years were used to develop a model training program and conducting in-service workshops for teachers instructing other teachers. Also, packets were developed at Western Michigan University and they included:

1. Background information about the metric system in other nations and the changeover in the United States to this system.
2. A description of the role home economists played in implementing this changeover both in the classroom and in the students' homes.
3. Suggested learning experiences.
4. Inexpensive teaching aids and transparency masters.
5. Lists of sources from which teachers could obtain other teaching aids.

Fitted kits were also prepared to use in various in-service programs for vocational areas of home economics and industrial arts. These kits included measuring devices, course outlines, and audio visual materials. To acquaint the public with the impact of conversion to metric at home and on the job, a one-hour videotape was developed for television (Parker, 1973; Intellect, 1973).

Another project funded by the U. S. Office of Education was the Metric Education project for Vocational Education at Ohio State University. The contract extended from July, 1974, to June, 1977, and concerned the development and utilization of metric education instructional materials in vocational, technical, and adult education. One of their projects was to develop and test metric instructional packages for selected occupational areas in each of the 15 OSOE Career Education clusters and adult education. Training workshops were conducted for selected vocational and adult education participants in each of the 10 USOE regions. Also, they developed an implementation guide for establishing metric education programs in local vocational and adult education programs (American Metric Journal, 1974).

Another large multi-state grant was awarded to North Carolina, California, Minnesota, Mississippi, and Delaware by the U. S. Office of Education. These five states were pioneers in metric education and developed working models and facilitated cooperation between educational agencies, private industry and the general public. These projects helped tremendously in our 10-year conversion to the metric system (American Metric Journal, 1974).

Many school districts have converted to the metric system and each system devised methods for achieving their goals. One method was used by teachers at Taft Middle School in Marion, Ohio, to develop an interdisciplinary approach for providing students a working knowledge of the metric system of measurement. The month of May was designated as "Metric Month" and each department was invited to participate in the program. The social studies class studied the history of the metric system, its usage in the world today, and the socio-political aspects of a nationwide change in measurement. The students used the meter, liter, and grams in their science classes. English classes discussed the vocabulary of the metric system and incorporated the vocabulary in creative writing exercises. Posters, badges, and slogans proclaiming "Metric Month" were made and displayed by the art classes. Students used the metric system in measuring and cooking in their home economics classes. The school was measured in metric units by the math classes and metric verses were put to popular songs and jingles by the music classes. The physical education department concluded "Metric Month" by having Taft School Olympic Games using metric distances. The pilot program helped students become familiar with the metric system (Morehouse and Schoonmaker, 1975).

As we began teaching the metric system, we were faced with many problems. The problems increased because a flood of inaccurate and inadequate products flooded the market. Judy Oppert (1975) tried to solve some problems by providing principles or generalizations to use when teaching anyone above the elementary level. These principles were:

1. Understanding the need for adopting the metric system and its impact on the nation as well as on home economics, persuaded people to learn the metric system.
2. Converting from the customary measurement system to metric or vice versa was confusing, involved many mathematical calculations, took a lot of time, created a false complexity about the metric system and helped to maintain the customary system.
3. Illustrating the relationships between metric units of length, area, volume, and mass helped students understand the logic, simplicity, and design of the metric system.
4. Emphasizing measurement activities where the students were actively involved in the measurement processes and experiences helped the students develop an understanding of the metric system.
5. Consistency in spelling, notation for decimal placement and terminology eliminated needless confusion.

6. The continued use of customary and metric units made it more difficult to unlearn the customary measurements and conversion from one unit to another became an undesirable practice.
7. The use of metric measurement in the home and community reinforced the school activities and aided learning and retention.
8. If the students gained self-confidence in working with the metric units they were more likely to continue using them in situations outside the classroom.
9. Conversion costs were reduced by timing the replacement of appropriate items so they were coordinated and replaced at the end of their regular lifespan, whenever possible.

Regardless of how school districts or universities introduced the metric system, they shared some common problems. One major problem was thoroughly preparing teachers to teach the metric system. Teachers had to avoid integrating the teaching of the metric system with the teaching of standard measurements. Also, it was necessary to revise or replace textbooks, courses of study, curriculum guides and other "software". It was necessary to replace current measuring devices with metric tools in classrooms, laboratories and industrial art departments. Purchasing departments had to learn metric specifications and cooks learned to adjust to using metric recipes. Also, home economics departments had to convert units for measuring length, weight, capacity, and temperature.

Teaching the Metric System

There was very limited information available on strategies for teaching the metric system. Most information concerned materials that were available, but there was no endorsement of materials to help in the selection of accurate useful tools for instruction. The National Bureau of Standards was available to review any documents concerning the metric system. However, the submitter of the document retained complete authority as to how he used the comments from the review (Roberts, 1974). In 1974, the National Bureau of Standards published a booklet listing references on metric information. A bibliography for quick reference or sources of information for supplementary materials was published by the Center for Science and Mathematics at Ohio State University (Bitter and Geer, 1975). Materials on teaching metric were readily available, but their effectiveness for teaching metric had not been determined.

The only study this investigator found comparing two methods of instruction in the metric system was done by Pigford (1974). One method was lecture-demonstration and individuals recorded results of the activities performed by the lecturer. The other method was using the laboratory and each subject handled equipment and participated in measurement and estimation of activities. The students were preservice elementary teachers and no differences between groups were found on either the posttest or the retention test. On the basis of this study, the investigator recommended that the lecture-demonstration method be used in situations where cost-effectiveness was a consideration.

A review of research studies on the teaching of the metric system was done by Murphy and Polzin (1969). A review of the research studies produced the following conclusions:

1. Students in selected high schools in 1929 possessed an inadequate knowledge of the metric system and of the relationship between the metric and English units.

2. Thirty-four percent of the problems in three selected high school chemistry textbooks in 1930 were in metric units.
3. There was evidence of the metric controversy in many of the studies on teaching the metric system.
4. Recent research suggested that the metric system should be taught in the private and public schools and the English system should be de-emphasized.
5. Elementary pupils and teachers, high school pupils, and college juniors selected for study had difficulty in appraising quantiative values.
6. Modern school mathematics instruction was often superior to traditional instruction of selected seventh grade pupils in the area of measurement.
7. Research studies in the area of measurement and the metric system were few.

Teaching the metric system was gaining more attention as evidenced by a recent study conducted by Kennedy (1975). This investigator wanted to determine the reliability of the use of advance organizers to enhance the retention of metric system concepts. The students were randomly assigned to one of three treatment groups. Group I received an investigator-developed comparative advance organizer prior to instruction in the metric system. Group II received an investigator written historical account of its development; and Group III received no prior instruction and was used for control purposes. The results indicated that the comparative advance organizers had potential that needed to be more fully utilized.

An important consideration in the conversion to the metric system was the kind and amount of education needed for the effective use of the metric system by adults. The words "adult education" had many different interpretations, but in the United States it was an umbrella term for voluntary, part-time programs or the "fourth-force" in education. At least 13 million Americans were involved in adult education experiences each year. This "fourth-force" became a major vehicle for interpreting and teaching the metric system to adult Americans. The importance of adult education as a means of bringing about conversion to the metric system was realized. Also, adult educators planned adult education courses to bring about a rapid and effective conversion. This required creating specific curricula and procedures to accomplish this goal. Teachers were trained to teach the courses and suitable instructional materials were developed (Cartwright, 1971).

Adams (1975) conducted a study to identify effective means of educating the general public to think in terms of the metric system. Odom (1973) stressed the importance of having people learn to use metric units only. He believed the best way to learn metric was by using and this brought about needed familiarity. "Think Metric" was his other idea in teaching metric so it became a part of daily living.

Programmed Instruction as a Teaching Device

The use of programmed instruction was presented as a new development in teaching methodology. Pressey (1927), one of the early pioneers in the development of programmed instruction, developed a testing-teaching machine at Ohio State University which was used for instruction and grading of papers. Eight years of work with automated teaching devices were evaluated by Pressey (1932) and he concluded that teaching machines helped students to learn and many man hours were saved in grading papers. Pressey's pioneer work of the 1920's met with little public approval and he regretfully dropped further work on auto-instruction in 1932. A quarter of a century elapsed between these first experiments and the introduction of the teaching machine by B. F. Skinner (1954).

A considerable amount of research was conducted on programmed instruction during the last 15 years. This research left little doubt that programs do teach, regardless of the kind of program or the kind of students. Frequently programs taught as well as a teacher and sometimes better (Fry, 1963). Programs have been used successfully at all educational levels. They have been used to teach a variety of subject matter, verbal, and manual skills (Hendershot, 1967; Programmed Instruction Materials, 1962; Spaulding, 1967).

Programmed materials required the student to answer questions and then provided him or her with immediate knowledge of results. This knowledge of results reinforced correct responses and the student traveled through a series of sequential steps, always informed of his progress. There were two basic types of programmed instruction: linear programming and branch programming. Markle (1964) summarized linear programming by listing three basic principles: active responding, minimal errors (because the student learned the responses he made), and knowledge of results (confirmation of correct responses and correction of any errors that occur). In linear programming the student made a response and compared his answer with the answer on the same page.

On the other hand, the branching program required the student to select one of three or four responses and then turn to another page to check his answer. If the response was correct, instructions were given on how to proceed. If the response was incorrect, the student was given additional information and reselected an answer from the choices. Crowder (1958) described the system as adapting itself to the student's achievement and knowledge. Generally, the branching format permitted the more capable students to by-pass the material he would have covered in a linear program. Experimental evidence did not conclusively favor one programming technique over the other; both are in use today, although the majority of the programs were linear according to Silverman (1967).

Silverman (1967) did a study comparing linear versus branching programs and multiple choice versus constructed response modes in a natural science course. The results of the study produced no evidence showing the superiority of the branching format or the linear format. The branching technique took less time than did the linear program, but no significant difference was shown by either group on the criterion test. They did find that small steps took significantly more time but produced significantly higher criterion scores than did the large step format.

These two main types of programs had some common characteristics. Each was an attempt to make learning controllable and predictable and to make it more efficient. Each was concerned with a very careful sequencing of materials to minimize learning difficulties. Each presented the material to be learned in units, although step size differed. Active responding by the student was required in each type, although the response served different purposes and could be made by writing the answer in one case and by thinking it in the other. Errors were of concern in both types of programs. Although a wrong answer was thought to be detrimental to learning in the linear and was used to explain misunderstandings and increase learning in the branching. Feedback was viewed as reinforcement which increased the probability of the response recurring in the linear, while its purpose was to supply the learner with information in the branching (Crowder, 1958).

Much of the work on programmed instruction was done under the auspices of some branch of the armed services. Much of Pressey's (1926, 1932) work was for the Navy and some of Skinner's (1959) work was for the Navy. The focus of early military efforts was on devices for development and assessment of particular skills, but some was directed toward practical self-instruction and supporting research. Several military training devices constructed in the 1940's and 1950's were developed to teach skills by individualized self-instructional methods. The greatest number of studies and use of programmed instruction were in the military services. Business and industry were second and education was third (Downing, 1965).

Programmed Instruction in Home Economics

In 1963, the Journal of Home Economics reported on the adaptation of programmed instruction to home economics. Nelson (1966) reported a study conducted at Cornell, Syracuse and the Universities of Buffalo and Rochester. New approaches to the development and evaluation of teacher preparation were investigated in the six year inter-institutional study. Nelson (1966, p. 39) stated that "possibilities of the use of programmed instruction in certain phases of professional home economics education are being explored with programs developed for the project." The programs developed for the Inter-University project were written by Lund (1963). It was concluded from Lund's research that automated instruction was one method for effectively presenting some subject matter to undergraduates in home economics education.

For many years home economists have been trying to take care of the individual differences of students; they have made an effort to individualize the courses of study for the students. In 1963, Huffman conducted a study to determine teacher attitudes toward programmed instruction, the teacher interests in programmed instruction, and their willingness to use programmed materials in their classes. A slight majority of the teachers sampled indicated programmed instruction could be more effective and efficient than the conventional methods of instruction in teaching factual information. The areas of clothing, housing, and foods were most often recommended for future programs. It was agreed by 80 percent of the teachers that programmed instruction should be used to implement the basic course rather than become the basic course.

Reigel (1964) found no significant differences in a study between the conventional method of teaching ninth grade home economics classes and the programmed method of instruction. It was found that students using programmed materials completed the material to be learned in less time than students learning by the conventional method.

The Diabetes and Arthritis program of the Public Health Service explored the possibility of using automated instruction for teaching the diabetic. A pilot test using programmed instruction for teaching diabetics was described by Skiff (1965). The objective of the program was to find a method which could conserve increasingly scarce professional time, and could be used where no patient instruction previously existed. The program provided individual instruction, presented standardized information in small steps, demanded patient involvement, immediately confirmed or corrected the reader's response, and permitted the learner to go at his own pace. The conclusion reached after the pilot test was that programmed instruction promised to be a useful part of a planned teaching program after further testing and evaluation.

According to Markovich and Campbell (1968), programmed instruction provided a learning situation in the area of food science. The purpose of their study was to determine the effectiveness of the procedure rather than its effectiveness relative to that of another method of presentation. The programmed text used for this study covered four plans of food science and was evaluated by a class of 16 students. The better students tended to excel consistently, while the weaker students generally remained at the bottom of the class. The most apparent weakness cited by the students was lack of variety in presentation of frames. A majority of the student subjects expressed approval of the active participation required by programmed instruction.

Many teaching machines were produced for school use in the 1950's and in the 1960's, but they served only as a means of presenting learning materials, informing the student of his progress, and tabulating his errors. It became obvious, according to Murphey (1968), that this type of machine could be no better than the programs put into it. It was discovered that programs in book form could be very effective without benefit of a machine. Since 1965, the emphasis has been on producing learning mateials and studying the process of programming.

The use of the filmstrip, "Taking Care of Diabetics", which was programmed by Marian Heglund Sierra-Franco for the Auto Tutor Mark II machine was reported by McDonald and Kaufman (1963). This program was designed to be used as a tool along with individual counseling and group classes. The teaching machine was selected by McDonald and Kaufman as the first step in putting responsibility for self care in the hands of the diabetic student. It was felt that programmed instruction was effective in teaching diabetic patients to care for themselves.

Programmed instruction in basic nutrition, according to Kiang (1970), was an effective teaching methodology for five-year baccalaureate nursing students. The students were divided into three groups. Group I received programmed instruction; Group II was given assigned readings; and Group III was the control group and given no instruction. The students who received programmed instruction in basic nutrition had a mean score of 43.27 as compared to a mean score of 34.27 for the students who had assigned readings covering the same material. The students who had the assigned readings had higher scores than the control group who had a mean score of 25.00. The t value exceeded t 0.01 = 3.05 and indicated a significant difference in pre- and post-test scores of those using programmed instruction. The time needed for completion of the programmed material was about the same as that required for the assigned readings.

Tani and Hankin (1971) developed the audio visual self-learning program, based on the principles of programmed learning for assisting patients with diabetes in their dietary management and for supplementing the individual interview of the dietitian. The program featured colored slides synchronized with tape recordings and was divided into two parts for two successive clinic vists by the patient. The results indicated that the new and traditional methods were comparable for retention of knowledge and that programmed learning could extend the professional expertise of the dietitian or nutritionist.

Reich (1971) reported in the Journal of Home Economics on her research of a programmed course in basic clothing for college students. The research involved development of a linear program for teaching basic principles of clothing construction to students with varying degrees of clothing construction experience. The program was intended to help students reach the concept level of learning while integrating manual skills with formal knowledge. Analysis of data generated from the program was encouraging, the students seemed to like the individual approach to learning. The final revision of the program was completed and published by a commercial publisher.

A study was done by Klein (1971) using seventh grade students comparing clothing instruction taught by a programmed learning text, Sewing Step by Step, with that of students taught by traditional teaching methods in a team-teaching situation. The experiment involved a control of 64 students and an experimental group of 111 students from a high school in Wisconsin. The results of the study showed that achievement was as great or greater with the experimental group as with the control group. The differences were not significant when the data were analyzed.

Gaffney (1971) developed and evaluated instructional components for three selected concepts in textiles in a college textiles course. Mean gain scores were computed to determine student's gain after the program was completed. The results of the study indicated that programmed instruction can be effectively utilized in teaching the basic concepts in textiles. The group using the programmed instructional component scored significantly higher (0.01) than did the group using the traditional lecture method. A mean time of 69.05 minutes was used to complete the programmed components as compared to seven hours for the traditional group. Seventy percent of the students liked the program. It was concluded that the developed materials were appropriate for the target population.

A comparison of the effectiveness of programmed instruction and an educational film for training food service personnel about prevention of falls was done by Gault (1972). Fourteen food service employees received training on the prevention of falls in the kitchen by viewing an educational film. Twelve food service employees received training on the same topic by completing a unit of programmed instruction. Both experimental groups indicated equivalent knowledge, by pretest scores, concerning the prevention of falls at the beginning of the study. Comparison of initial and second post-test scores indicated that comparable amounts of learning and retention occurred when either the educational film or programmed instruction was used. Either of these training techniques or the two techniques in combination offered possibilities for the dietitian to maintain a continuing training program for food service personnel.

An investigation of the effectiveness of teaching basic food safety principles for consumers by programmed instruction was done by Howard in 1975. The difference between initial behavior and terminal behavior of subjects using the programmed text was assessed in relation to the terminal objectives of the programmed material. The criterion test and programmed text were administered to two groups of consumers consisting of 20 subjects and 17 subjects. A positive change in scores between the pretest and post-test was significant at the 0.001 level for both groups.

The results obtained indicated that food safety could be taught effectively to consumers through programmed instruction.

Posey (1975) developed a self-instructional system to teach metric temperature to adults and students in the tenth grade or above. The system was to meet the following criteria: individualized, enjoyable, inexpensive, suitable for home as well as classroom use, and appropriate for use by homemakers and consumers. Mastery level was arbitrarily set at students achieving 80 percent or better on the post-test. Eighty-three percent of the 106 subjects scored better than 80 percent on the post-test. Scores increased an average of 51 points between the pretest and the post-test.

There was no complete theory of learning. No theory takes into account all types of learning. It has been amply demonstrated that programmed instruction was a useful and efficient method of learning. The full potential of programmed instruction to control and predict learning cannot yet be achieved. It just may be that programmed instruction may be the means through which a more complete theory of learning may be developed. Programmed instruction was a method that offered great potential as students tried to master the vast amount of knowledge required.

Summary

Chapter II presented the history of the metric system in the United States, a definition of the metric system and why the United States converted to the metric system. Also, the metric system and its relation to home economics and education was explored. One method of instruction, programmed instruction, and research utilizing programmed instruction was reviewed. The review of studies confirmed the need for carefully designed and controlled studies evaluating metric teaching strategies.

CHAPTER III

RESEARCH PROCEDURES

Based on the Metric Conversion Act of 1975 and the increased usage of the metric system of measurement, the writer decided to investigate research and related literature that dealt with the metric system of measurement. Research dealing with effective strategies for teaching the metric system to home economists was unavailable. This led to the decision to investigate strategies for teaching dietitians basic information about the metric system and to identify implications about the metric system for teaching dietitians. The procedure and methods described in this chapter were followed to accomplish the objectives of this study as outlined in Chapter I.

Research Design

The objectives of this study guided the author in the kind of research needed for the study. The research design called for finding out if knowledge of the metric system (dependent variable) could be affected by how (the methods or techniques) this knowledge was gained. The researcher was interested in discovering if dietitians gained as much metric knowledge using programmed instruction as those given instruction in the classroom with participant interaction.

This research design used the "Nonequivalent Control Group Design" (Campbell and Stanley, 1963). The design is diagrammed as follows:

$$\begin{array}{ccc} O_1 & X_1 & O_2 \\ O_3 & X_2 & O_4 \\ O_5 & & O_6 \end{array}$$

in which:

1. The treatment given the two groups was indicated by the symbols X_1 and X_2. The participants that used the traditional lecture method of instruction were designated as X_1; and X_2 designation was used for the programmed method of instruction. The instructional materials were developed and tested by the researcher to meet the objectives of the program and the same material was presented in both methods of instruction.
2. A pretest (Metric Skills I, Appendix B) was administered to all participants so the effects of the two teaching strategies could be analyzed. The pretest was represented in the diagram by the symbols O_1, O_3 and O_5. Analysis of Variance was used to test for significant differences between the means of the three groups and the F value was 0.1262 or the difference in the groups was not statistically significant.
3. A post-test (Metric Skills II, Appendix C) was administered to all participants and the post-tests were represented in the diagram by the symbols O_2, O_4 and O_6. The post-test was administered to all participants at the end of instruction to determine if the treatments did have an effect on the amount of metric knowledge. Due to the short period of time between administration of the pretest and post-test, equivalent forms of the pretest and post-test were used.
4. In the diagram, Group I or the traditional lecture method of

instruction was represented by the symbols O_1 X_1 O_2; Group II or the programmed method of instruction was represented by the symbols O_3 X_2 O_4; and Group III or the control group was represented by the symbols O_5 O_6.

Each row in the diagram represented a group of professionally employed, registered dietitians in the state of Oklahoma. In this study the groups did not have pre-experimental sampling equivalence, but the groups constituted assembled collectives as similar as availability permitted. The groups were similar because all participants were professionally employed, registered dietitians and qualifications necessary to become registered were designated by the American Dietetics Association.

The sample for the study was derived from a mailing list of dietitians in the state of Oklahoma provided by the Oklahoma Dietetics Association. The mailing list indicated the dietitians that were not registered. The Professional-Metric Questionnaire (Appendix A) and Metric Skills I (Appendix B) were mailed to all registered dietitians in the state of Oklahoma. If they were willing to participate in the study, the completed Professional-Metric Questionnaire and Metric Skills I were returned to the researcher. The 68 participants indicated on the questionnaire which of the three groups they wished to be assigned as part of the metric study (self-selection).

Instrumentation

Development of the Questionnaire, Pretest, and Post-Test

The three instruments developed by the researcher for use in this study were the Professional-Metric Questionnaire, Metric Skills I (pretest), and Metric Skills II (post-test). The pretest and post-test were designed so the effects of two teaching strategies could be analyzed. The Professional-Metric Questionnaire was designed to obtain professional information and attitudes toward metric conversion from the sample. Objective, multiple-choice type questions were developed to obtain this information. The questionnaire was composed of 16 questions: questions one through eight were designed to obtain professional information; questions 9 through 15 were designed to obtain information about attitudes toward metric conversion; and question 16 was designed for the participants to select their group for participation in the metric study. The following professional information was solicited from the dietitians in the sample:

a. ADA membership classification,

b. type of professional training,

c. current professional position,

d. professional participation--meetings, conventions attended,

e. route for becoming registered,

f. length of time as a professional member,

g. undergraduate grade-point-average, and

h. highest degree held.

The second part of the questionnaire dealt with attitudes about metric conversion. The following information was solicited:

a. attitude about metric conversion,

b. knowledge of the metric system,

c. how the metric knowledge was obtained,

d. method of instruction preferred,

e. ownership of metric measures (tools, devices),

f. type of metric measures owned, and

g. use of metric measures.

The questionnaire was developed by the researcher; three home economics graduate classes at Oklahoma State University evaluated the questionanire for appropriateness and clarity. The instrument was revised to incorporate their suggestions. Then, the questionnaire was field tested in the state of Kentucky by 20 professionally employed, registered dietitians and their suggestions were incorporated before the instrument was administered to the sample dietitians.

Pre- and post-tests were constructed by the researcher to evaluate comprehension of metric information by the participants. The researcher identified the objectives of the two instructional programs (traditional lecture method and programmed instruction) with the same material being presented in the two programs. A grid was developed to determine the number of questions needed to represent each of the nine areas identified in the instructional programs. The result was a pretest and posttest, each with 60 objective, multiple-choice questions. The questions were divided as follows:

Questions 1 through 2----Introduction to the Metric System (Unit I)

Questions 3 through 6----Prefixes (Unit II)

Questions 7 through 11---Decimal Review (Unit III)

Questions 12 through 21--Metric Length (Univ IV)

Questinos 22 through 31--Metric Volume (Unit V)

Questions 32 through 41--Metric Weight (Unit VI)

Questions 42 through 47--Metric Temperature (Unit VII)

Questions 48 through 50--Metric Energy (Unit VIII)

Questions 51 through 60--Rules for Metric Usage and Conversion (Unit IX)

The pretest and post-test were evaluated by two graduate home economics classes at Oklahoma State University for clarity. Suggested changes were made in the instruments. Then the pretest and post-test were evaluated by a panel of judges knowledgeable of the metric system to determine content validity of the instruments.

The pre- and post-tests were designed as equivalent forms (Metric Skills I and Metric Skills II) because of the short span of time between the two administrations. Each form was a cross-sectional sample of the same group of items. The pretest and post-test were administered to three graduate classes at Oklahoma State University to determine if they were equivalent forms. Class I took the pretest first and a week later took the post-test; Class II took the post-test first and the pretest a week later; and Class III was divided so that half of the class took the pretest the first week and half of the class took the post-test the first week and the procedure was reversed the second week. There was no significant difference in the groups, as determined by the Analysis of Variance statistical procedure. It was determined that the pretest and post-test were equivalent forms.

Metric Treatment Programs

After stating the objectives for the metric programs for dietitians, the decision was made to test possible alternative methods of teaching the metric system to dietitians. The researcher attended a metric workshop at Oklahoma State University and reviewed books on the metric system to determine the alternate methods of teaching to be used in the study and the metric information that would be provided in the programs. The researcher decided to use two methods of teaching the metric system to dietitians: the traditional lecture method of instruction and programmed instruction.

After reviewing books on the metric system and attending the metric workshop, the researcher decided each program would consist of nine units, and the information presented in the two programs would be the same because of the design of the study. The first unit of each program would be an introduction to enable the participants to understand why the United States was converting to the metric system and providing motivation for learning the metric system.

The second unit dealt with six prefixes that were important in learning the metric system. The prefixes would be used with all metric units in the program except metric temperature. The third unit would be a decimal review to prepare participants for arithmetic in the metric system of measurement, as the metric system is a decimal system. The last six units of the instructional program would require the participants to use decimals.

Information included in most books about the metric system included information about metric length, metric volume, metric weight, and metric temperature. The order and method of presentation varied, but the researcher decided to divide the information into the following four units: metric length, metric volume, metric weight, and metric temperature. The eighth unit in the programs would deal with metric energy because of the importance of energy measurements in the dietitians professional roles.

The researcher found when reviewing books on the metric system that International System of Units (SI) rules for metric usage were not always followed and decided that information on rules for metric usage should be included in the instructional program. The final information that the researcher decided to include in the instructional programs was conversion information that dietitians would need during the conversion period in meeting professional responsibilities to the public. Therefore, the nine units were as follows:

Unit I------Introduction to the Metric System

Unit II-----Prefixes

Unit III----Decimal Review

Univ IV-----Metric Length

Unit V------Metric Volume

Unit VI-----Metric Weight

Unit VII----Metric Temperature

Unit VIII---Metric Energy

Unit IX-----Rules for Metric Usage and Conversion

The traditional lecture method of instruction was presented by the researcher in a metric workshop held on two consecutive Fridays at Oklahoma State University. Based on information from other metric workshops, the workshop was held on two consecutive Fridays to give participants an opportunity to review and apply the many new concepts presented.

The workshop had a 15-hour contact limit set by the researcher. The number of hours for the workshop was based on results of other metric workshops reviewed by the researcher that state 10 to 15 hours of training were needed to learn the metric system. The researcher chose the maximum number of hours for the workshop.

The format followed during the metric workshop was the researcher presenting information using the traditional lecture-discussion method of instruction with transparencies to illustrate the concepts presented. After a unit had been presented, the participants practiced using the information that had been presented. The practice problems were then discussed by the researcher and participants to insure an understanding of the concepts presented. A summary of the major concepts was given before moving to the next unit. The lecture method of presentation used approximately two-fifths of the contact time and the practice time and discussion used approximately three-fifths of the contact time. A sample of the lecture material can be found in Appendix D.

The programmed method of instruction presented the same material as the lecture method of instruction. The same procedure was used, that is concepts were presented with illustrations to emphasize the concepts and the same practice problems used in the workshop were included for the programmed method participants. The participants were to solve the problems, check their answers with the answer sheet on the next page and if any of the answers were incorrect they were to be erased. The participants would then reread the material and rework the practice problems. Again this was to insure an understanding of the information before proceeding to the next unit. A sample of the programmed material can be found in Appendix E.

Statistical Procedures

The hypotheses of this study determined the statistical procedures used for analyzing the data. Three statistical procedures (Analysis of Variance, the Scheffe Test, and Pearson Product-Moment Correlation) were used. Analysis of Variance was used to analyze hypotheses I through IV and hypotheses VII, VIII, IX, XIII and XIV to test the significance of differences between the means of the groups. For this statistical procedure, the 0.05 level of significance was used to accept or not to accept the hypotheses.

The second statistical procedure, the Scheffe Test, was used to determine between which groups there was a significant difference, if a significant difference was indicated by the Analysis of Variance (F value). The Scheffe Test was used on the same hypotheses (I through IV, VII, VIII, IX, XIII and XIV) as the Analysis of Variance, if the F value indicated there was a significant difference between the means of the groups. Edwards (1962, p. 154) stated that "this test can be appropriate for making any and all comparisons of interest between a set of k means, including those comparisons that may be suggested by the values of the means themselves." The .10 level of significance was set as the level for determining if there was a significant difference between the groups, because the Scheffe method is more rigorous than other multiple comparison methods. This is Scheffe's recommendation (Ferguson, 1966).

The last statistical procedure used for analyzing the data was the Pearson Product-Moment Correlation. The Pearson Product-Moment Correlation was used for correlating intevening variables (specific professional data and attitudes) and dependent variables (knowledge of the metric system). The Pearson Product-Moment Correlation was used to determine the relationship of hypotheses VI, VI, X, XI, XII, XV, XVI, and XVII to knowledge of the metric system. The 0.05 level of confidence was used for accepting or not accepting the hypotheses.

<u>Hypothesis I</u>

H_1 was stated as follows: there will be no significant difference in the pretest scores (Metric Skills I) of dietitians receiving the traditional lecture method of instruction, those using programmed instructional materials, and those of the control group. This hypothesis was analyzed, by use of the Analysis of Variance statistical procedure, to determine if there was a significant difference between the means of the three groups. The formula used for this statistical procedure (Analysis of Variance) was:

$$F = \frac{(\bar{X}_1 - \bar{X}_2)^2}{s_w^2/n_1 + s_w^2/n_2}$$

This formula was from Ferguson (1966, p. 296).

The techniques used were as follows:

1. the sum of the squares for each of the separate groups was computed (within sum of squares)
2. the sum of the squares for the total group was computed (total sum of squares)
3. the within sum of squares was subtracted from the total sum of squares (between sum of squares)
4. the within and between sum of squares was divided by the degrees of freedom associated with each to obtain the mean squares (Popham, 1967, pp. 164-166).

The degrees of freedom was obtained by:

5. dividing the between mean squares by the within mean squares and this yielded the F value
6. then the F value was checked for level of probability from the Distribution of F table (Popham, 1967, p. 167).

If there was a significant difference between the means (F value), then the second statistical procedure was used to compare the means to determine where the significant difference was located. In this hypothesis, the Scheffe Test was used to analyze the means of Group I and Group II, Group I and Group III, and Group II and Group III to determine where there was a significant difference. The formula used for the Scheffe Test was:

$$F = \frac{(\bar{x}_1 - \bar{x}_2)^2}{\frac{s^2w}{n_1} + \frac{s^2w}{n_2}}$$

$\bar{x}_1$ = the mean of the first group

$\bar{x}_2$ = the mean of the second group

s^2w = the within group mean squares

n_1 = number of group one

n_2 = number of group two (Ferguson, 1966, pp. 296-297).

To evaluate the F of the formula, it was compared with F' and F' was defined as:

$F' = (k-1)(F\alpha(df_1, df_2))$

k = number of groups

df_1 = degrees of freedom between groups

df_2 = degrees of freedom within groups (Ferguson, 1966, pp. 296-297.

Hypothesis II

H_2 was stated as follows: there will be no significant difference in the post-test scores (Metric Skills II) of dietitians receiving traditional lecture instruction, those using programmed instruction, and those of the control group. This hypothesis was analyzed by using the Analysis of Variance statistical procedure to determine if there was a significant difference between the means of the three groups. The Scheffe Test was used, if the F value was significant, to determine if the significant difference in the means was between Group I and Group II, Group I and Group III, or Group II and Group III.

Hypothesis III

H_3 was stated as follows: there will be no significant difference in the pretest (Metric Skills I) and the post-test (Metric Skills II) scores of the dietitians receiving the traditional lecture method of instruction, those receiving programmed instruction, or those of the control group. This hypothesis was analyzed by using the Analysis of Variance statistical procedure to determine if there was a difference between the means of the three groups. If the F value was significant, then the Scheffe Test was used to determine if the difference in the means was between Group I and Group II, Group I and Group III, or Group II and Group III.

Hypothesis IV

H_4 was stated as follows: there will be no significant difference in the nine sections of the pretest and post-test of dietitians receiving the traditional lecture method of instruction, those using programmed instruction, or those of the control group. Each section of the pretest and post-test scores was statistically analyzed using the Analysis of Variance statistical procedure to determine if there was a significant difference between the mean scores of the groups. The Scheffe Test was used, if the F value was significant, to determine if the difference in the means was between Group I and Group II, Group I and Group III, or Group II and Group III.

Hypothesis V

H_5 was stated as follows: there will be no significant relationship in comprehension of the metric system by dietitians and years of membership in the American Dietetics Association. This hypothesis was statistically analyzed by using the Pearson Product-Moment Correlation. The formula for the correlation coefficient was:

$$r = \frac{\Sigma xy}{\sqrt{(\Sigma x^2)(\Sigma y^2)}}$$

xy is the product of each x and y for every individual
x^2 is the sum of the squared deviations from the mean in x
y^2 is the sum of the squared deviations from the mean in y
(Edwards, 1967, p. 102).

The steps used in the calculation of the Pearson r were:

1. Divide the sheet into columns labeled: individual; X (score on X); Y (score on Y); x (deviation of mean of X from each X); y (deviation of mean of Y from each Y); x^2 (square of each deviation in X); y^2 (square of each deviation in Y); and xy (product of each deviation score of X and Y).
2. Enter each individual's score for both X and Y in the appropriate columns. Sum these columns and find the mean of X and the mean of Y.
3. Subtract the mean of X from each score in column X and enter in column x. Subtract the mean of Y from each score in Y and enter in column y.
4. Square each value of x and enter in the x^2 column. Similarly, square each value of y and enter in the y^2 column. Sum these two columns to obtain the sum of x^2 and the sum of y^2.
5. Multiply each individual's x value by his y value and enter in the xy column. Sum this column to obtain the sum of xy.
6. Prepare a summary table listing the values of the mean of x, the mean of y, the sum of x^2, the sum of y^2, and the sum of xy.
7. Substitute in the above formula (Bartz, 1966, pp. 47-48).

The correlation coefficient was interpreted from the perfect positive +1.0, to the perfect negative -1.0. The extreme values are rarely obtained in practice, but as the coefficient ranges from 0.0 +1.0, the relationship becomes greater until the relationship is perfect, +1.0. A confidence level of 0.05 was set for accepting or not accepting this hypothesis.

Hypothesis VI

H_6 was stated as follows: there will be no significant relationship in comprehension of the metric system by dietitians and the number of professional meetings and/or continuing education classes attended. This hypothesis was statistically analyzed by use of the Pearson Product-Moment Correlation.

Hypothesis VII

H_7 was stated as follows: there will be no significant difference in comprehension of the metric system by dietitians and the type of professional position held. Analysis of Variance was the statistical procedure used to determine if there was a significant difference between the means of the groups. If the F value was significant, then the Scheffe Test was used to analyze where the difference in the means existed.

Hypothesis VIII

H_8 was stated as follows: there will be no significant difference in comprehension of the metric system by dietitians and the route (internship, degree, or experience) used to attain membership in the

American Dietetics Association. Analysis of Variance was the statistical procedure used to determine if there was a significant difference between the means of the groups. If there was a significant difference as determined by the F value, then the Scheffe Test was used to determine where the significant difference was located.

Hypothesis IX

H_9 was stated as follows: there will be no significant difference in comprehension of the metric system by dietitians and the highest degree held by the participant. Analysis of Variance was the statistical procedure used to determine if there was a significant difference between the means of the groups. If there was a significant difference as determined by the Analysis of Variance (F value), then the Scheffe Test was used to determine between which groups the significant difference was located.

Hypothesis X

H_{10} was stated as follows: there will be no significant relationship in comprehension of the metric system by dietitians and the participants undergraduate grade-point-average. The hypothesis was statistically analyzed by use of the Pearson Product-Moment Correlation.

Hypothesis XI

H_{11} was stated as follows: there will be no significant relationship in comprehension of the metric system by dietitians who favor, those who oppose, and those who are undecided about metric conversion.

This hypothesis was statistically analyzed by use of the Pearson Product-Moment Correlation.

Hypothesis XII

H_{12} was stated as follows: there will be no significant relationship in comprehension of the metric system by dietitians who have a workable knowledge of the metric system and those who do not have a workable knowledge. This hypothesis was statistically analyzed by use of the Pearson Product-Moment Correlation.

Hypothesis XIII

H_{13} was stated as follows: there will be no significant difference in comprehension of the metric system and how participants obtained a workable knowledge of the metric system. Analysis of Variance was the statistical procedure used to determine if there was a significant difference between the means of the groups. If there was a significant difference between the means (F value) then the Scheffe Test was used to determine between which groups the significant difference was found.

Hypothesis XIV

H_{14} was stated as follows: there will be no significant difference in comprehension of the metric system and the method of instruction preferred by the participants for learning the metric system. This hypothesis was statistically analyzed by using Analysis of Variance to determine if there was a significant difference between the means of the groups. If there was a significant difference between the means (F value), then the Scheffe Test was used to determine between which groups the significant difference was found.

Hypothesis XV

H_{15} was stated as follows: there will be no significant relationship in comprehension of the metric system by dietitians and owning or having available metric measuring equipment for use and those not having metric measuring equipment for use. This hypothesis was statistically analyzed by use of the Pearson Product-Moment Correlation.

Hypothesis XVI

H_{16} was stated as follows: there will be no significant relationship in comprehension of the metric system by dietitians and the number of metric measures they have available for use. The Pearson Product-Moment Correlation was the statistical procedure used to analyze this hypothesis.

Hypothesis XVII

H_{17} was stated as follows: there will be no significant relationship in comprehension of the metric system and if the participants often use, sometimes use, or never use metric measures. This hypothesis was statistically analyzed by use of the Pearson Product-Moment Correlation.

Selection of the Sample

The subjects of this study consisted of registered dietitians that were professionally employed in the state of Oklahoma. Oklahoma was chosen because the researcher was doing graduate study and the state association requested that metric information be provided for registered dietitians. Registered dietitians in Oklahoma should be representative of dietitians in all states because of requirements set by the American Dietetics Association for membership and registration.

When this study was conducted Oklahoma had approximately 300 dietitians in residence. A list of dietitians in the state of Oklahoma was supplied to the researcher by the Oklahoma Dietetics Association. The list indicated by registration number dietitians that were registered in ADA. Approximately 60 of the 300 dietitians in Oklahoma were not registered and could not be considered for the sample. All registered dietitians in Oklahoma were mailed the Professional-Metric Questionnaire, Metric Skills I (pretest), and a letter explaining how the metric study would be conducted and how they could participate in the study. Those dietitians willing to participate in the study completed the questionnaire and pretest and returned them to the researcher. The sample consisted of dietitians that met the sample criteria and were willing to participate in the metric study.

The sample dietitians for the metric study were divided into three groups: Group I or the traditional lecture method of instruction; Group II or programmed instruction; and Group III or the control group. Question 16 of the questionnaire was for participants to select the group they would participate in as part of the study. Campbell and Stanley (1963) described the design as "self-selected" when participants deliberately sought out their method of exposure to the study. In order to assure that the groups were not biased in their knowledge of the metric system, the researcher analyzed the pretest results and found there was no significant difference among the three groups in knowledge of the metric system.

The sample for Group I, the traditional lecture method of instruction, attended the metric workshop that was conducted at Oklahoma State University by the researcher on two consecutive Fridays. Twenty-two participants were in Group I. Group II, the programmed method of instruction, was determined by participants willing to complete the programmed instruction and meeting the sample criteria. Group II consisted of 21 participants. The programmed instructional materials that were developed and tested by the researcher, were mailed to all participants in Group II, so they were received when the metric workshop was being conducted and a deadline for completion of the program was given.

Group III, the control group, was determined by the participants willing to participate in the study by completing the questionnaire, pretest, and post-test. Group III consisted of 25 participants. Group I completed the post-test at the completion of the workshop. The post-test was mailed to Group II and Group III with a deadline given for them to be returned to the researcher.

CHAPTER IV

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The information in this chapter was based on data collected for this study from the instruments (questionnaire, pretest, and post-test) used to test the effectiveness of two teaching strategies and the variables associated with comprehension of the metric system by professionally employed, registered dietitians. The statistical findings and their significane were evaluated and presented.

Findings: Characteristics of Participants

Analysis of information about the participants revealed characteristics which were important for interpretation of the study. The information about the participants was made available from the responses of the mailed questionnaires. The number of completed questionnaires analyzed in the study was 68. The following information was analyzed: number of years the participants were members of the American Dietetics Association; professional meetings attended; professional position; route for achieving membership; highest degree held; undergraduate grade-point-average; attitude toward metric conversion; knowledge of the metric system; how the metric knowledge was obtained; preferred method for learning the metric system; available metric measuring equipment; the number of available metric measures; and how often the metric equipment was used. Tables XXX through XLII in Appendix F contain this information.

Years of Membership

Specific requirements for achieving membership in the dietetics profession were established by the American Dietetics Association. All 68 participants in the metric study were members of the American Dietetics Association. Sixteen of the participants (23.5 percent) were members for zero to two years, 12 participants (17.6 percent) were members for three to five years; seven participants (10.3 percent) were members for six to eight years; three participants (4.4 percent) were members for 9 to 11 years; three participants (4.4 percent) were members for 12 to 14 years; and 27 participants (39.7 percent) were members for over 14 years. More than one-third of the participants were members of the American Dietetics Association for over 14 years (Table XXX, Appendix F).

Professional Meetings

Of the 68 participants in the metric study, five participants (7.4 percent) had not attended a professional meeting or class during the past year. One professional meeting or class during the past year was attended by 15 participants (22.1 percent); two professional meetings or classes during the past year were attended by 21 participants (30.9 percent); three professional meetings or classes during the past year were attended by 17 participants (25.0 percent) and 10 of the participants (14.7 percent) had attended four professional meetings or classes. During the past year, two or three professional meetings were attended by 55.5 percent of the participants (Table XXXI, Appendix F).

Professional Position

Many types of professional positions were available for dietitians and several types were represented in the metric study. Twenty-nine (42.6 percent) of the 68 participants in the metric study were employed as clinical dietitians. From the remaining 39 participants, eight (11.8 percent) were employed as administrative dietitians; 13 (19.1 percent) were employed as consulting dietitians; nine (13.2 percent) were employed as teaching dietitians; one (1.5 percent) was employed as a research dietitian; and eight (11.8 percent) were employed in school lunch or public health. More than one-third (42.6 percent) of the participants were employed as clinical dietitians (Table XXXII, Appendix F).

Membership Route

Several routes for attaining membership were approved by the American Dietetics Association to provide the number of dietitians needed for professional positions. Forty-six (82.4 percent) of the 68 participants in the metric study attained membership by completing a dietetic internship. Two (2.9 percent) of the remaining participants attained membership by completing a traineeship; one (1.5 percent) participant attained membership by completing a preplanned work experience; six participants (8.8 percent) attained membership by completing a masters degree plus work experience; and three participants (4.4 percent) attained membership by completing the coordinated undergraduate program in dietetics. The dietetic internship is the oldest and most popular means of attaining membership as indicated by 56 (82.4 percent) of the metric study participants using this method for attaining membership (Table XXXIII, Appendix F).

Highest Degree

A bachelor's degree in dietetics was required before members could use one of the routes for attaining membership. Therefore, all participants in the metric study held a bachelor's degree, but some had completed requirements for higher degrees. Of the 68 participants in the metric study, the bachelor's degree was the highest degree held by 43 of the participants (63.2 percent). The master's degree was the highest degree held by 22 of the participants (32.4 percent) and a doctoral degree was held by three of the participants (4.4 percent) in the metric study. Therefore, a majority of the participants had not completed requirements for a degree other than the bachelor's degree (Table XXXIV, Appendix F).

Grade-Point-Average

The positions available for attaining membership in the dietetics profession were limited and the undergraduate grade-point-average was one criteria used in filling these positions. This was reflected in the grade-point-average of the participants. Only two (2.9 percent) of the 68 participants had an undergraduate grade-point-average of 1.5 to 2.5. Forty-five (66.2 percent) of the 68 participants had a grade-point-average of 2.6 to 3.5 and 21 (30.9 percent) of the 68 participants had a grade-point-average of 3.6 to 4.0, based on a 4.0 scale. A majority of the participants (66.2 percent) had an undergraduate grade-point-average of 2.6 (C+) to 3.5 (A-) (Table XXXV, Appendix F).

Metric Conversion Attitude

Forty-nine (72.1 percent) of the 68 participants in the metric study supported metric conversion; three participants (4.4 percent) opposed metric conversion; and 16 of the participants (23.5 percent) were undecided about metric conversion. A majority of the participants (72.1 percent) supported metric conversion and this will aid the metric conversion process (Table XXXVI, Appendix F).

Metric System Knowledge

Many workshops and classes have been held on the metric system of measurement. Dietitians used some metric measures in their professional positions. Therefore, it was important to know the number of participants who had a workable knowledge of the metric system prior to participating in the metric study. Twenty-seven (39.7 percent) of the 68 participants said they had a workable knowledge of the metric system and 41 (60.3 percent) of the participants said they did not have a workable knowledge of the metric system. One finding pointed out that a majority (60.3 percent) of the participants recognized they needed knowledge of the metric system (Table XXXVII, Appendix F).

Acquired Knowledge

A variety of methods for learning the metric system was available and of the 27 participants that indicated they had a workable knowledge of the metric system, two of the participants (7.4 percent) said they obtained their knowledge by attending a workshop. Two (7.4 percent) of the participants said they completed programmed instruction, six (22.2 percent) said they obtained their knowledge by attending a university or extension class; and 17 (63.0 percent) said they obtained their knowledge of the metric system by self-taught instruction. A majority (63.0 percent) of the 27 participants wrote they had gained knowledge of the metric system on their own by helping children or studying whatever information was available (Table XXXVIII, Appendix F).

Instruction Preferred

As the United States moves toward conversion to the metric system of measurement, accepted or preferred methods of instruction for learning the metric system were needed in order to meet the needs of dietitians. Twenty-six (38.2 percent) of the 68 participants stated that the method of instruction preferred for learning the metric system was the workshop. Twenty-three of the participants (33.8 percent) preferred programmed instruction as the method for learning the metric system; 12 of the participants (17.6 percent) preferred taking a university or extension class; five of the participants (7.4 percent) preferred telelecture; and two of the participants (2.9 percent) preferred television as the method for learning the metric system. Seventy-two percent of the participants preferred either a workshop or programmed instruction for learning the metric system (Table XXXIX, Appendix F).

Available Metric Measures

Metric measures have been available for many years in the United States, but they have received more emphasis since the Metric Conversion

Act of 1975 was passed. Of the 68 participants in the study, 39 (57.4 percent) said they owned or had available metric measures for use. Twenty-nine of the participants (42.6 percent) said they did not own or have available metric measuring equipment for use. Therefore, a majority had available or owned metric measuring equipment (Table XL, Appendix F).

Number of Metric Measures

Of the 39 participants that said they owned or had available metric measuring equipment for use, 15 (38.4 percent) said they had one type of metric measure for use. Fourteen (35.9 percent) of the 39 participants said they had two types of metric measures for use; six (15.4 percent) of the 39 participants said they had three types of metric measures for use; and four (10.3 percent) of the 39 participants said they had four types of metric measures for use. A majority (74.3 percent) of the 39 participants said they had one or two metric measures for use (Table XLI, Appendix F).

Use of Metric Equipment

The participants were asked if they used the metric equipment they owned. Of the 68 participants in the study, three participants (4.4 percent) said they often used metric measuring equipment. Twenty-nine of the participants (42.6 percent) said they sometimes used metric measuring equipment; and 36 of the participants (52.9 percent) said they never used metric measuring equipment. Therefore, owning equipment does not necessarily indicate using the equipment. A majority of the participants owned one or more metric measures and a majority of the participants said they never use metric measuring equipment (Table XLII, Appendix F).

Research Summary

More than one-third of the 68 professionally employed, registered dietitians in the study were members of the American Dietetics Association for over 14 years and were employed as clinical dietitians. The participants were interested in professional growth because a majority indicated they had attended two or three professional meetings during the past year.

All participants held a bachelor's degree, but less than two-fifths had completed requirements for a higher degree. Two-thirds of the participants indicated they had an undergraduate grade-point-average between a C+ and A-. After completion of the bachelor's degree more than 80 percent achieved membership in ADA by completing a dietetic internship.

Metric conversion was supported by a majority of the participants and they recongized they needed knowledge of the metric system. Almost three-fourths of the participants stated that they preferred a workshop or programmed instruction for learning the metric system. However, of those that indicated they had knowledge of the metric system, a majority had gained the knowledge on their own.

Between one and four metric measures were available for a majority of the participants to use. However, a majority indicated they never use metric measuring equipment.

Conclusions

Conclusions drawn from this study were presented with the statistical analysis that provided the basis for the conclusions. This included data used to determine if the null hypotheses were accepted or not accepted.

Pretest Analysis

The assessment of metric knowledge by participating dietitians resulted in pretest scores (Metric Skills I) for the three groups participating in the metric study. The pretest was administered to all participants so the effects of the two teaching strategies could be analyzed. The dietitians were allowed to choose their group (traditional lecture method of instruction, programmed instruction, or control group) for participation in the study. This resulted in 22 participants in Group I (those receiving the traditional lecture method of instruction); 21 in Group II (those using programmed instruction); and 25 in Group III (those of the control group).

Even though the groups were similar (professionally employed, registered dietitians from the state of Oklahoma), it was necessary to statistically determine that the groups were from the same population before proceeding with the study. Analysis of Variance was the statistical procedure used to determine if the groups were from the same population. Hypothesis I stated there will be no significant difference in the pretest scores of dietitians receiving the traditional lecture method of instruction, those receiving programmed instruction, and those of the control group. The pretest means and standard deviations were presented in Table III.

TABLE III

PRETEST MEANS AND STANDARD DEVIATIONS OF THE THREE GROUPS IN THE STUDY

Group	Number	Mean	Standard Deviation
Group I	22	37.9091	9.0759
Group II	21	42.0000	8.9387
Group III	25	43.1600	9.0170

Analysis of Variance was used to indicate if there was a significant difference between the means of the three groups. Table IV contained these data. The critical F value for the given degrees of freedom (2, 65) at the .05 level of significance was 3.14. The Analysis of Variance yielded an F value of 2.137 which was less than the critical value of 3.14. This indicated there was no significant difference between the means of the pretest scores of the three groups at the .05 level of significance. Therefore Hypothesis I, that there will be no significant difference in the pretest scores of dietitians receiving the traditional lecture method of instruction, those receiving programmed instruction, and those of the control group, was accepted.

The Scheffe Test was not used on Hypothesis I because there was no significant difference between the means of the three groups' pretest scores. The researcher concluded that the three groups were similar in knowledge of the metric system and proceeded with the study.

TABLE IV

ANALYSIS OF VARIANCE--THREE PRETEST GROUPS OF PARTICIPATING DIETITIANS

Source	DF	Sum of Squares	Mean Squares	F
Between Groups	2	347.1015	173.5507	2.137
Within Groups	65	5279.1731	81.2180	
Total	67	5626.2734		

Post-Test Analysis

Level of metric knowledge of the participating dietitians (after completion of the workshop and programmed instruction and for the control group) was obtained from the post-test (Metric Skills II). The post-test was administered to the three groups during the same time period, so the time between the pretest and post-test would be the same for all groups. Table V contained post-test means and standard deviation data.

Hypothesis II stated there will be no significant difference in the post-test scores (Metric Skills II) of dietitians receiving the traditional lecture method of instruction, those using programmed instruction, and those of the control group. Analysis of Variance was the statistical procedure used to determine if Hypothesis II would be accepted or not accepted. The critical F value for the given degrees of freedom (2, 65) at the .05 level of significance was 3.14. The Analysis of Variance yielded an F value of 21.995, which was more than the critical F value of 3.14. This indicated there was a significant difference between the means of the three groups' post-test scores at the .95 level of significance. Therefore Hypothesis II, there will be no significant difference in the post-test scores of dietitians receiving the traditional lecture method of instruction, those using programmed instruction, and those of the control group, was not accepted. Table VI contained these data.

TABLE V

POST-TEST MEANS AND STANDARD DEVIATIONS OF THE THREE GROUPS IN THE STUDY

Group	Number	Mean	Standard Deviation
Group I	22	54.3182	3.4557
Group II	21	55.0000	4.2895
Group III	25	44.2400	8.9456

The Scheffe Test was used to statistically analyze Hypothesis II because a significant difference between the means of the three post-test groups was indicated by the Analysis of Variance statistical procedure. The Scheffe Test was used to determine if the significant difference in the post-test means was between Group I and Group II, Group I and Group III, and/or Group II and Group III. The Scheffe Test results were compared with the F' value to determine if a significant difference existed between the means of the two groups. The F' value of 4.78 was derived from the following statistical procedure and is the F' value for all statistical comparisons involving the Scheffe Test (Ferguson, 1966, pp. 296-297):

$$
\begin{aligned}
F' &= (k-1)(F\alpha(df_1, df_2)) \\
&= (2)(2.39) \\
F' &= 4.78
\end{aligned}
$$

TABLE VI

ANALYSIS OF VARIANCE--THREE POST-TEST GROUPS OF PARTICIPATING DIETITIANS

Source	df	Sum of Squares	Mean Squares	F
Between Groups	2	1718.5756	859.2876	21.995*
Within Groups	65	2539.3285	39.0666	
Total	67	4257.9023		

*Significant beyond .05 level.

The F value that resulted, when the means of Group I and Group II (post-test) were compared, was .1273 and the F' value for comparison was 4.78. The F value was less than the F' value, therefore a significant difference did not exist between the means of Group I and Group II beyond the .10 level of significance.

The F value that resulted, when the means of Group I and Group III were compared (Scheffe Test), was 30.42. The F value was greater than the F' value (4.78), indicating a significant difference between the means of Group II and Group III beyond the .10 level of significance.

TABLE VII

SCHEFFE TEST--BETWEEN MEAN POST-TEST COMPARISONS

Group	Number	Mean	Mean Squares	F	F
Group I Group II	22 21	54.3182 55.0000	39.0666	.1278	4.78
Group I Group III	22 25	54.3182 44.2400	39.0666	30.42*	4.78
Group II Group III	21 25	55.0000 44.2400	39.0666	33.82*	4.78

*Significant beyond the .10 level.

The Analysis of Variance statistical procedure indicated there was a significant difference between the post-test means of the three groups in the metric study. Therefore Hypothesis II, there will be no significant difference between the post-test scores of dietitians receiving the traditional lecture method of instruction, those using programmed instruction, and those of the control group, was not accepted.

The Scheffe Test was used to determine if the significant difference was between the means of Group I and Group II, Group I and Group III, and/or Group II and Group III. The F value (Scheffe Test) indicated there was no significant difference between Group I (those receiving the traditional lecture method of instruction) and Group II (those receiving programmed instruction). However, there was a significant difference between Group I and Group III (the control group) and Group II and Group III. From the above results, the researcher concluded there was no significant difference between the groups receiving either traditional lecture or programmed instruction, but there was a significant difference between the groups receiving instruction (either traditional lecture or programmed) and the control group in their knowledge of the metric system.

Pretest Section Scores Analysis

The pretest and post-test were equivalent forms and composed of 60 objective, multiple choice questions. Each test was divided into nine sections corresponding to the units in the programs of instruction. Each section was analyzed to determine if there was a significant difference between the means of the three groups. The pretest section means and standard deviations were presented in Table VIII.

Hypothesis III stated there will be no significant difference in the nine section pretest scores (Metric Skills I) of dietitians receiving the traditional lecture method of instruction, those using programmed materials, and those of the control group. Analysis of Variance was the statistical procedure used to indicate if there was a significant difference between the means of the three groups in each of the nine sections of the pretest (Metric Skills I). The critical F value with 2 and 65 degrees of freedom and a significance of .05 was 3.14. The F values of Section I (0.655), Section II (0.330), Section III (2.307), Section IV

TABLE VIII

PRETEST SECTIONS MEANS AND STANDARD DEVIATIONS FOR THE THREE GROUPS OF DIETITIANS

Test Section	Number of Questions	Group	Number in Group	Mean	Standard Deviation
I--Introduction	2	Group I	22	1.0455	0.5755
I--Introduction	2	Group II	21	1.2381	0.5390
I--Introduction	2	Group III	25	1.1600	0.5538
II--Prefixes	4	Group I	22	2.9545	0.7222
II--Prefixes	4	Group II	21	3.1905	1.2091
II--Prefixes	4	Group III	25	3.1200	0.9713
III--Decimal Reviews	5	Group I	22	4.8636	0.3512
III--Decimal Reviews	5	Group II	21	5.0000	0.0
III--Decimal Reviews	5	Group III	25	4.8000	0.4082
IV--Metric Length	10	Group I	22	6.2273	1.5715
IV--Metric Length	10	Group II	21	6.8095	2.2939
IV--Metric Length	10	Group III	25	7.2000	2.0000
V--Metric Volume	10	Group I	22	6.6818	2.3782
V--Metric Volume	10	Group II	21	7.4762	2.1822
V--Metric Volume	10	Group III	25	8.4000	2.1794
VI--Metric Weight	10	Group I	22	5.3636	1.9651
VI--Metric Weight	10	Group II	21	6.8095	1.4007
VI--Metric Weight	10	Group III	25	7.0400	1.7436
VII--Metric Temperature	6	Group I	22	3.5909	2.1080
VII--Metric Temperature	6	Group II	21	4.4286	1.6903
VII--Metric Temperature	6	Group III	25	3.6400	1.4107

TABLE VIII (Continued)

Test Section	Number of Questions	Group	Number in Group	Mean	Standard Deviation
VIII--Metric Energy	3	Group I	22	1.3636	1.1358
VIII--Metric Energy	3	Group II	21	0.9048	1.1792
VIII--Metric Energy	3	Group III	25	1.5200	1.1590
IX--Usage and Conversion	10	Group I	22	5.7727	2.5991
IX--Usage and Conversion	10	Group II	21	6.1429	1.8784
IX--Usage and Conversion	10	Group III	25	6.2800	1.6713

(1.430), Section VII (1.572), Section VIII (1.697), and Section IX (0.367) were less than the critical F value (3.14). This indicated there was no significant difference between the means of the three groups in these sections of the pretest. However, the F values of Section V (3.444) and Section VI (6.279) were greater than the critical F value (3.14), indicating there was a significant difference between the means of the three groups for two sections of the pretest. Table IX presented these data.

Hypothesis III stated there will be no significant difference in the nine section pretest scores of dietitians receiving the traditional lecture method of instruction, those using programmed instruction, and those of the control group, was not completely accepted because there was a significant difference between the means of two sections of the pretest and not a significant difference between the means of the other seven sections of the pretest. The Scheffe Test was used to statistically analyze Section V and Section VI means to determine if the significant difference was between the means of Group I and Group II, Group I and Group III, and/or Group II and Group III.

The F value that resulted when the means of Group I of pretest, Section V, were compared was 1.344. The F value was less than the F' value (4.78), indicating no significant difference between the means of Group I and Group II of pretest, Section V, at the .10 level of significance.

The F value that resulted when Group I and Group III means were compared was 6.846. The F value was greater than the F' value (4.78), indicating a significant difference between the means of Group I and Group III of pretest, Section V, at the .10 level of significance.

TABLE IX

ANALYSIS OF VARIANCE--PRETEST SECTION SCORES FOR THE THREE GROUPS OF DIETITIANS

Section	Source	df	Sum of Squares	Mean Squares	F
I--Introduction	Between Groups	2	0.4053	0.2027	1.697
I--Introduction	Within Groups	65	20.1240	0.3096	
I--Introduction	Total	67	20.5294		
II--Prefixes	Between Groups	2	0.6379	0.3190	0.330
II--Prefixes	Within Groups	65	62.8325	0.9667	
II--Prefixes	Total	67	63.4704		
III--Decimal Review	Between Groups	2	0.4678	0.2339	2.307
III--Decimal Review	Within Groups	65	6.5909	0.1014	
III--Decimal Review	Total	67	7.0587		
IV--Metric Length	Between Groups	2	11.1335	5.5668	1.430
IV--Metric Length	Within Groups	65	253.1013	3.8939	
IV--Metric Length	Total	67	264.2346		
V--Metric Volume	Between Groups	2	34.7541	17.3770	3.444*
V--Metric Volume	Within Groups	65	328.0104	5.0463	
V--Metric Volume	Total	67	362.7644		
VI--Metric Weight	Between Groups	2	37.3436	18.6718	6.279*
VI--Metric Weight	Within Groups	65	193.2887	2.9739	
VI--Metric Weight	Total	67	230.6323		
VII--Metric Temperature	Between Groups	2	9.5879	4.7939	1.572
VII--Metric Temperature	Within Groups	65	198.2207	3.0495	
VII--Metric Temperature	Total	67	207.8086		

TABLE IX (Continued)

Section	Source	df	Sum of Squares	Mean Squares	F
VIII--Metric Energy	Between Groups	2	4.5508	2.2754	1.697
VIII--Metric Energy	Within Groups	65	87.1402	1.3406	
VIII--Metric Energy	Total	67	91.6910		
IX--Usage and Conversion	Between Groups	2	3.1572	1.5786	0.367
IX--Usage and Conversion	Within Groups	65	279.4747	4.2996	
IX--Usage and Conversion	Total	67	282.6318		

*Significant beyond .05 level.

The F value, that resulted when the means of Group II and Group III were compared, was 1.930. The F value was less than the F' value, indicating there was no significant difference between the means of Group II and Group III of the pretest, Section V, at the .10 level of significance.

The means of Group I and Group II, Group I and Group III, and Group II and Group III of pretest, Section VI, were compared to determine where there was a significant difference. The F value that resulted, when the means of Group I and Group II were compared, was 7.55. The F value was greater than the F' value (4.78), indicating there was a significant difference between the means of Group I and Group II of pretest, Section VI, at the .10 level of significance.

The F value that resulted, when the means of Group I and Group III were compared, was 11.05. The F value was greater than the F' value, indicating there was a significant difference between the means of Group I and Group III of pretest, Section VI, at the .10 level of significance.

The F value that resulted, when the means of Group II and Group III were compared, was 0.204. The F value was less than the F' value, indicating no significant difference between the means of Group II and Group III of pretest, Section VI, at the .10 level of significance. These data were presented in Table X.

In conclusion, based on the Analysis of Variance and Scheffe Test statistical findings, Hypothesis III could not be completely accepted. The Analysis of Variance statistical findings indicated no significant difference between the means of the three groups for Sections I, II, III, IV, VII, VIII, and IX, but there was a significant difference between the means of the three groups for Section V (metric volume) and

Section VI (metric weight). The significant difference between the means for Section V was between Group I (traditional lecture group) and Group III (the control group). The significant difference between the means for Section VI was between Group I and Group II (programmed instruction group) and Group I and Group III. By examination of the mean scores, Group I appeared to have had lower means than the other two groups on these two sections.

TABLE X

SCHEFFE TEST--SECTIONS V AND VI PRETEST COMPARISONS OF THE THREE GROUPS OF DIETITIANS

Group	Section	Number	Mean	Mean Squares	F	F'
Group I	V	22	6.6818	5.0463	1.344	4.78
Group II	V	21	7.4762			
Group I	V	22	6.6818	5.0463	6.846*	4.78
Group III	V	25	8.4000			
Group II	V	21	7.4762	5.0463	1.930	4.78
Group III	V	25	8.4000			
Group I	VI	22	5.3636	2.9737	7.55*	4.78
Group II	VI	21	6.8095			
Group I	VI	22	5.3636	2.9737	11.05*	4.78
Group III	VI	25	7.0400			
Group II	VI	21	6.8095	2.9737	0.204	4.78
Group III	VI	25	7.0400			

*Significant beyond the .10 level.
df = (2, 65)

<u>Analysis of Post-Test Section Scores</u>

The post-test was divided into nine sections corresponding to the units in the instructional program. Each section was statistically analyzed to determine if there was a significant difference between the means of the three groups. The post-test section means and standard deviations were presented in Table XI.

<u>Hypothesis IV</u> stated there will be no significant difference in nine section scores of the post-test (Metric Skills II) of dietitians receiving the traditional lecture method of instruction, programmed instruction, and those of the control group. Analysis of Variance was the statistical procedure used to indicate if there was a significant difference between the means of the three groups in each of the nine sections of the post-test (Metric Skills II). The critical F value for the given degrees of freedom (2, 65) at the .05 level of significance was 3.14. The F values of Section I (16.660), Section II (10.758), Section IV (6.242), Section V (20.915), Section VI (9.554), Section VII (22.736), Section VIII (5.391), and Section IX (5.163) were greater than the critical F value (3.14). This indicated there was a significant difference between the means of the three groups for eight sections of the post-test. The F value for Section III was 1.193 and this was less than the critical F value (3.14), indicating there was no significant difference between the means of the three groups for Section III of the post-test. These data were presented in Table XII.

The Scheffe Test was used to statistically analyze Sections I and II and Sections IV through IX to determine if the significant difference was between the means of Group I and Group II, Group I and Group III,

TABLE XI

MEANS AND STANDARD DEVIATIONS FOR POST-TEST MEANS OF THE THREE GROUPS OF DIETITIANS

Test Section	Number of Questions	Group	Number in Group	Mean	Standard Deviation
I--Introduction	2	Group I	22	1.7273	0.4558
I--Introduction	2	Group II	21	1.9048	0.3008
I--Introduction	2	Group III	25	1.0400	0.7348
II--Prefixes	4	Group I	22	3.9545	0.2132
II--Prefixes	4	Group II	21	3.9048	0.3008
II--Prefixes	4	Group III	25	3.0800	1.1518
III--Decimal Review	5	Group I	22	4.6818	0.5679
III--Decimal Review	5	Group II	21	4.9048	0.3008
III--Decimal Review	5	Group III	25	4.8000	0.5000
IV--Metric Length	10	Group I	22	9.6364	0.6580
IV--Metric Length	10	Group II	21	9.3333	1.0646
IV--Metric Length	10	Group III	25	8.2000	2.1409
V--Metric Volume	10	Group I	22	9.4091	0.7341
V--Metric Volume	10	Group II	21	9.2857	0.9024
V--Metric Volume	10	Group III	25	7.4400	1.6093
VI--Metric Weight	10	Group I	22	9.2727	0.9351
VI--Metric Weight	10	Group II	21	9.0952	1.0443
VI--Metric Weight	10	Group III	25	7.5200	2.1432
VII--Metric Temperature	6	Group I	22	5.0909	1.1916
VII--Metric Temperature	6	Group II	21	5.3810	0.8047
VII--Metric Temperature	6	Group III	25	3.3600	1.2543

TABLE XI (Continued)

Test Section	Number of Questions	Group	Number in Group	Mean	Standard Deviation
VIII--Metric Energy	3	Group I	22	2.5455	0.5958
VIII--Metric Energy	3	Group II	21	2.5238	0.6016
VIII--Metric Energy	3	Group III	25	1.8400	1.1431
IX--Usage and Conversion	10	Group I	22	8.0000	1.7995
IX--Usage and Conversion	10	Group II	21	8.6667	1.3904
IX--Usage and Conversion	10	Group III	25	6.9600	2.1307

TABLE XII

ANALYSIS OF VARIANCE--POST-TEST SECTION SCORES WITH THREE GROUPS OF DIETITIANS

Section	Source	df	Sum of Squares	Mean Squares	F
I--Introduction	Between Groups	2	9.8080	4.9040	16.660*
I--Introduction	Within Groups	65	19.1331	0.2944	
I--Introduction	Total	67	28.9411		
II--Prefixes	Between Groups	2	11.4549	5.7274	10.758*
II--Prefixes	Within Groups	65	34.6040	0.5324	
II--Prefixes	Total	67	46.0588		
III--Decimal Review	Between Groups	2	0.5354	0.2677	1.193
III--Decimal Review	Within Groups	65	14.5822	0.2243	
III--Decimal Review	Total	67	15.1177		
IV--Metric Length	Between Groups	2	27.2276	13.6138	6.242*
IV--Metric Length	Within Groups	65	141.7574	2.1809	
IV--Metric Length	Total	67	168.9850		
V--Metric Volume	Between Groups	2	57.7654	28.8827	20.915*
V--Metric Volume	Within Groups	65	89.7637	1.3810	
V--Metric Volume	Total	67	147.5292		
VI--Metric Weight	Between Groups	2	44.2191	22.1095	9.554*
VI--Metric Weight	Within Groups	65	150.4129	2.3140	
VI--Metric Weight	Total	67	194.6320		
VII--Metric Temperature	Between Groups	2	56.3372	28.1686	22.736*
VII--Metric Temperature	Within Groups	65	80.5304	1.2389	
VII--Metric Temperature	Total	67	136.8676		

TABLE XII (Continued)

Section	Source	df	Sum of Squares	Mean Squares	F
VIII--Metric Energy	Between Groups	2	7.6385	3.8193	5.391*
VIII--Metric Energy	Within Groups	65	46.0525	0.7085	
VIII--Metric Energy	Total	67	53.6910		
IX--Usage and Conversion	Between Groups	2	34.2555	17.1277	5.163*
IX--Usage and Conversion	Within Groups	65	215.6263	3.3173	
IX--Usage and Conversion	Total	67	249.8818		

*Significant beyond .05 level.
df = (2, 65)

and/or Group II and Group III of each section. The F value that resulted, when the means of Group I and Group II of post-test, Section I were compared, was 1.1498. The F value was less than the F' value (4.78) and this indicated there was no significant difference between the means of Group I and Group II of post-test, Section I at the .10 level of significance.

The F value that resulted, when the means of Group I and Group III were compared, was 18.77. The F value was greater than the F' value (4.78) and this indicated there was a significant difference between the means of Group I and Group III of post-test, Section I at the .10 level of significance.

The F value for comparing the means of Group II and Group III was 28.99. The F value was greater than the F' value and this indicated there was a significant difference between the means of Group II and Group III for post-test, Section I at the .10 level of significance. These data were presented in Table XIII.

These comparisons indicated there was no significant difference between the means of the participants receiving instruction, either traditional lecture or programmed, but there was a significant difference between the means of participants receiving instruction (either traditional lecture or programmed) and the control group. Therefore, it was concluded that either method of instruction increased the participants knowledge of an introduction to the metric system (Section I).

The Scheffe Test was used to determine if there was a significant difference between the means of Group I and Group II, Group I and Group III, and Group II and Group III of Section II in the post-test. Group I and Group II means of post-test, Section II were compared to determine if there was a significant difference between the means, and the F value that resulted was 0.0498. The F value was less than the F' value (4.78) and this indicated there was no significicnat difference between the means of Group I and Group II of Section II in the post-test at the .10 level of significance.

TABLE XIII

SCHEFFE TEST--POST-TEST, SECTION I MEAN COMPARISONS FOR THE PARTICIPATING DIETITIANS

Group	Number	Mean	Mean Squares	F	F'
Group I	22	1.7273	0.2944	1.1498	4.78
Group II	21	1.9048			
Group I	22	1.7273	0.2944	18.776*	4.78
Group III	25	1.0400			
Group II	21	1.9048	0.2944	28.99*	4.78
Group III	25	1.0400			

*Significant beyond the .10 level.
df = (2, 65)

The F value that resulted, when comparing the means of Group I and Group III of Section II in the post-test, was 16.809. The F value was greater than the F' value (4.78) and this indicated there was a significant difference between the means of Group I and Group III of post-test, Section II at the .10 level of significance.

Group II and Group III means of Section II in the post-test were compared to determine if there was a significant difference between the means, and the resulting F value was 14.58. The F value was greater than the F' value (4.78) and this indicated there was a significant difference between the means of Group II and Group III of Section II in the post-test at the .10 level of significance. These results were presented in Table XIV.

TABLE XIV

SCHEFFE TEST--POST-TEST, SECTION II MEAN COMPARISONS OF THE PARTICIPATING DIETITIANS

Group	Number	Mean	Mean Squares	F	F'
Group I	22	3.9545	0.5324	.0498	4.78
Group II	21	3.9048			
Group I	22	3.9545	0.5324	16.809*	4.78
Group III	25	3.0800			
Group II	21	3.9048	0.5324	14.58*	4.78
Group III	25	3.0800			

*Significant beyond .10 level.
df = (2, 65)

These comparisons of means indicated there was no significant difference between the means of the participants receiving either traditional lecture or programmed instruction, but there was a significant difference between the means of participants receiving instruction (either traditional lecture or programmed) and the control group. Therefore, it was concluded that either method of instruction increased the participants knowledge of prefixes used in the metric system (Section II).

The Scheffe Test was used to determine if there was a significant difference between the means of Group I and Group II, Group I and Group III, and/or Group II and Group III of Section IV, post-test at the .10 level of significance. Group I and Group II means of Section IV in the post-test were compared to determine if there was a significant difference between the means, and the resulting F value was 0.4517. The F value was less than the F' value (4.78) and this indicated there was no significant difference between the means of Group I and Group II of Section IV of the post-test at the .10 level of significance.

The F value that resulted, when comparing the means of Group I and Group III of Section IV in the post-test was 11.07. The F value was greater than the F' value (4.78) and this indicated there was a significant difference between the means of Group I and Group III of post-test, Section IV at the .10 level of significance.

Group II and Group III means of Section IV in the post-test were compared to determine if there was a significant difference between the means and the F value that resulted was 6.70. The F value was greater than the F' value (4.78) and this indicated there was a significant difference between the means of Group II and Group III of Section IV in the post-test at the .10 level of significance. These data were presented in Table XV.

The results of the comparisons of means indicated there was no significant difference between the means of the participants receiving either traditional lecture or programmed instruction, but there was a significant difference between the means of the participants receiving instruction (either traditional lecture or programmed) and those of the control group. Therefore, it was concluded that either method of instruction increased the participants knowledge of metric volume (Section V).

TABLE XV

SCHEFFE TEST--POST-TEST, SECTION IV MEAN COMPARISONS OF PARTICIPATING DIETITIANS

Group	Number	Mean	Mean Squares	F	F'
Group I	22	9.6364	2.1809	.4517	4.78
Group II	21	9.3333			
Group I	22	9.6364	2.1809	11.07*	4.78
Group III	25	8.2000			
Group II	21	9.3333	2.1809	6.70*	4.78
Group III	25	8.2000			

*Significant beyond .10 level.
df = (2, 65)

The Scheffe Test was used to determine if there was a significant difference between the means of Group I and Group II, Group I and Group III, and/or Group II and Group III of Section V in the post-test at the .10 level of significance. Group I and Group II means of Section V were compared to determine if there was a significant difference between the means and the F value that resulted was 0.1184. The F value was less than the F' value (4.78), and this indicated there was no significant difference between the means of Group I and Group II of Section V in the post-test at the .10 level of significance.

The F value of the means comparisons of Group I and Group III of Section V was 32.86. The F value was greater than the F' value (4.78) and this indicated there was a significant difference between the means of Group I and Group III of Section V in the post-test at the .10 level of significance.

The F value that resulted when the means of Group II and Group III of post-test, Section V were compared was 28.15. The F value was greater than the F' value (4.78) and this indicated there was a significant difference between the means of Group II and Group III of post-test, Section V at the .10 level of significance. These data were presented in Table XVI.

TABLE XVI

SCHEFFE TEST--POST-TEST, SECTION V MEAN COMPARISONS OF PARTICIPATING DIETITIANS

Group	Number	Mean	Mean Squares	F	F'
Group I	22	9.4091	1.3810	.1184	4.78
Group II	21	9.2857			
Group I	22	9.4091	1.3810	32.86*	4.78
Group III	25	7.4400			
Group II	21	9.2857	1.3810	28.15*	4.78
Group III	25	7.4400			

*Significant beyond .10 level.
df = (2, 65)

The results of the comparisons of means indicated there was no significant difference between the means of the participants receiving either traditional lecture or programmed instruction, but there was a significant difference between the means of the participants receiving instruction (either traditional lecture or programmed) and those of the control group. Therefore, it was concluded that either method of instruction increased the participants knowledge of metric volume (Section V).

The Scheffe Test was used to indicate if there was a significant difference between the means of Group I and Group II, Group I and Group III, and/or Group II and Group III in Section VI of the post-test at the .10 level of significance. The result of comparing the means of Group I and Group II was an F value of 0.1463. The F value was less than the F' value (4.78) and this indicated there was no significant difference between the means of Group I and Group II of Section VI in the post-test at the .10 level of significance.

When Group I and Group III of Section VI were compared, the F value that resulted was 5.05. The F value was greater than the F' value (4.78) and this indicated there was a significant difference between the means of Group I and Group III of Section VI in the post-test at the .10 level of significance.

Group II and Group III means of Section VI were compared to determine if there was a significant difference between the means and the F value that resulted was 12.24. The F value was greater than the F' value and this indicated there was a significant difference between the means of Group II and Group III of Section VI in the post-test at the .10 level of significance. These data were presented in Table XVII.

TABLE XVII

SCHEFFE TEST--POST-TEST, SECTION VI MEAN COMPARISONS OF PARTICIPATING DIETITIANS

Group	Number	Mean	Mean Squares	F	F'
Group I	22	9.2727	2.3140	0.1463	4.78
Group II	21	9.0952			
Group I	22	9.2727	2.3140	5.05*	4.78
Group III	25	7.5200			
Group II	21	9.0952	2.3140	12.24*	4.78
Group III	25	7.5200			

*Significant beyond .10 level.
df = (2, 65)

The results of these comparisons of means indicated there was no significant difference between the means of the participants receiving either traditional lecture or programmed instruction, but there was a significant difference between the means of the participants receiving instruction (either traditional lecture or programmed) and those of the control group. Therefore, it was concluded that either method of instruction increased the participants knowledge of metric volume (Section VI). Thus, even though there were significant differences in Sections V and VI in the pretest for Group I, there were no significant differences evidenced in these two sections in the post-test for this group.

The Scheffe Test was used to indicate if there was a significant difference between the means of Group I and Group II, Group I and Group III, and/or Group II and Group III in Section VII in the post-test at the .10 level of significance. The result, of comparing the means of Group I and Group II, was an F value of 0.7298. The F value was less than the F' value (4.78) and this indicated there was no significant difference between the means of Group I and Group II of Section VII in the post-test.

When the means of Group I and Group III were compared, the F value was 28.29. The F value was greater than the F' value (4.78) and this indicated there was a significant difference between the means of Group I and Group III of Section VII in the post-test.

Group II and Group III means were compared and the F value that resulted was 37.63. The F value was greater than the F' value and this indicated there was a significant difference between the means of Group II and Group III of Section VII in the post-test. Table XVIII presented these data.

TABLE XVIII

SCHEFFE TEST--POST-TEST, SECTION VII MEAN COMPARISONS OF PARTICIPATING DIETITIANS

Group	Number	Mean	Mean Squares	F	F'
Group I	22	5.0909	1.2389	0.7298	4.78
Group II	21	5.3810			
Group I	22	5.0909	1.2389	28.28*	4.78
Group III	25	3.3600			
Group II	21	5.3810	1.2389	37.63*	4.78
Group III	25	3.3600			

*Significant beyond .10 level.
df = (2, 65)

The results of the comparisons of means indicated there was no significant difference between the means of the participants receiving either traditional lecture or programmed instruction, but there was a significant difference between the means of participants receiving instruction (either traditional lecture or programmed) and those of the control group. Therefore, it was concluded that either method of instruction increased the participants knowledge of metric temperature (Section VII).

The Scheffe Test was used to determine if there was a significant difference between the means of Group I and Group II, Group I and Group III, and/or Group II and Group III of Section VIII in the post-test at the .10 level of significance. The result of comparing the means of Group I and Group II was an F value of 0.0071. The F value was less than the F' value (4.78), indicating there was no significant difference between the means of Group I and Group II of Section VIII, comprehension of the metric system, on the post-test.

Group I and Group III means were compared and the result was an F value of 8.22. The F value was greater than the F' value indicating there was a significant difference between the means of Group I and Group III of Section VIII in the post-test.

When the means of Group II and Group III were compared, the F value was 7.53. The F value was greater than the F' value, indicating there was a significant difference between the means of Group II and Group III of post-test, Section VIII. Table XIX presented these data.

The results of the comparisons of means indicated there was no significant difference between the means of participants receiving instruction (either traditional lecture or programmed), but there was a significant difference between the means of the participants receiving instruction (either traditional lecture or programmed) and those of the control group. Therefore, it was concluded that either method of instruction increased the participants knowledge of metric energy (Section VIII).

TABLE XIX

SCHEFFE TEST--POST-TEST, SECTION VIII MEAN COMPARISONS OF PARTICIPATING DIETITIANS

Group	Number	Mean	Mean Squares	F	F'
Group I	22	2.5455	0.7085	0.0071	4.78
Group II	21	2.5238			
Group I	22	2.5455	0.7085	8.22*	4.78
Group III	25	1.8400			
Group II	21	2.5238	0.7085	7.53*	4.78
Group III	25	1.8400			

*Significant beyond .10 level.
df = (2, 65)

The Scheffe Test was used to indicate if there was a significant difference between the means of Group I and Group II, Group I and Group III, and/or Group II and Group III of Section IX, comprehension of rules of metric usage and conversion in the post-test. The result of comparing the means of Group I and Group II was an F value of 1.439. The F value was less than the F' value (4.78), indicating there was no significant difference between the means of Group I and Group II of post-test, Section IX at the .10 level of significance.

When Group I and Group III means were compared, the F value was 3.81. The F value was less than the F' value and this indicated there was no significant difference between the means of Group I and Group III of Section IX in the post-test at the .10 level of significance.

Group II and Group III means were compared and the result was an F value of 10.02. The F value was greater than the F' value, indicating a significant difference between the means of Group II and Group III of Section IX in the post-test at the .10 level of significance. Table XX presented these data.

TABLE XX

SCHEFFE TEST--POST-TEST, SECTION IX MEAN COMPARISONS OF PARTICIPATING DIETITIANS

Group	Number	Mean	Mean Squares	F	F'
Group I	22	8.0000	3.3173	1.439	4.78
Group II	21	8.6667			
Group I	22	8.0000	3.3173	3.815	4.78
Group III	25	6.9600			
Group II	21	8.6667	3.3173	10.02*	4.78
Group III	25	6.9600			

*Significant beyond .10 level.
df = (2, 65)

The results of the comparisons of means indicated there was no significant difference between the means of the participants receiving traditional lecture instruction and those receiving programmed instruction and no significant difference between the means of those receiving traditional lecture instruction and the control group. However, there was a significant difference between those receiving programmed instruction and those of the control group. Therefore, it was concluded that programmed instruction significantly increased knowledge of rules of metric usage and conversion by dietitians (Section IX).

Hypothesis IV stated there will be no significant difference between the means of the three groups in the nine sections of the post-test (Metric Skills II) of dietitians receiving the traditional lecture method of instruction, those receiving programmed instruction, and those of the control group. The hypothesis was not completely accepted because there was a significant difference between the means of the three groups in eight sections of the post-test, but there was no significant difference between the means of the three groups in Section III (Decimal Review).

There was no significant difference between the means of Group I (the traditional lecture method of instruction) and Group II (programmed instruction) in the eight sections of the post-test statistically analyzed by the Scheffe Test. There was a significant difference between the means of Group I (the traditional lecture method of instruction) and Group III (the control group) in all but Section IX (Rules for Metric Usage and Conversion) of the eight sections (post-test) statistically analyzed by the Scheffe Test. There was a significant difference between the means of Group II and Group III in all but eight sections analyzed by the Scheffe Test.

It was concluded that programmed instruction significantly increased knowledge of the metric system by dietitians in all areas except decimal review. The traditional lecture method of instruction significantly increased knowledge of the metric system by dietitians in all areas except decimal review and metric usage and conversion.

Years Membership in ADA and Knowledge of Metric System

The Pearson Product-Moment Correlation was used to determine if there was a significant relationship between the years of membership in ADA and metric comprehension. Hypothesis V stated there will be no significant relationship in comprehension of the metric system by dietitians and years of membership in ADA. The years of membership were correlated with the pretests and post-tests of the 68 participants and these data were presented in Table XLIII, Appendix G.

The correlation coefficient for the .05 level of significance with 65 degrees of freedom was .250 (Popham, 1967). The years of membership were negatively correlated with the pretest (-0.1285) and the post-test (-0.1593). The correlation coefficient between the years of membership and comprehension of the metric system was not significantly related because the r values were less than the correlation coefficient required for .05 level of significance (.250). Therefore, Hypothesis V, there will be no significant relationship in comprehension of the metric system by dietitians and years of membership in ADA, was accepted. The largest percentage of participants was members of ADA for over 14 years. The researcher concluded that since little emphasis was placed on knowledge of the metric system by the ADA this may account for the negative relationship between years of membership and knowledge of the metric system.

Professional Meetings Attended and Knowledge of Metric System

The Pearson Product-Moment Correlation was used to determine if there was a significant relationship between the number of professional meetings attended during the past year and knowledge of the metric system. Hypothesis VI stated there will be no significant relationship in comprehension of the metric system by dietitians and the number of professional meetings and/or continuing education classes attended. The number of professional meetings attended during the past year was correlated with the pretests and post-tests of the participants and these data were presented in Table XLIII, Appendix G.

The correlation coefficient for the .05 level of significance and degrees of freedom (65) was .250 (Popham, 1967). The number of professional meetings was correlated with the pretest and the result was an r of 0.1670 and the resulting post-test r was 0.2330. The correlation coefficient between the number of professional meetings attended and knowledge of the metric system was not significantly related because the r values were less than the correlation coefficient required for the .05 level of significance (.250). Therefore, Hypothesis VI, there will be no significant relationship in comprehension of the metric system by dietitians and the number of professional meetings attended during the past year was accepted. It was concluded that the number of meetings attended appeared to have no influence on knowledge of the metric system for these three groups of dietitians.

Professional Position and Knowledge of the Metric System

Hypothesis VII stated there will be no significant difference in comprehension of the metric system by dietitians and the type of professional position held. Analysis of Variance was used to determine if there was a significant difference between the means of the pretest groups and if there was a significant difference between the means of the post-test groups by professional position. The six types of professional positions were combined for this statistical analysis because of the small numbers in some of the groups. The result was four types of professional positions: clinical, administrative, consultant, and other positions.

The F value that resulted when comparing the means of the pretest groups was 1.236 and .616 was the F value that resulted when the means of the post-test groups were compared. The critical F value was 2.75 at the .05 level of significance with 3 and 64 degrees of freedom. Both of the F values were less than the critical F value and this indicated there was no significant difference between the means of the pretest groups and between the means of the post-test groups by professional position. *Hypothesis VII*, there will be no significant difference in comprehension of the metric system by dietitians and the type of professional position held, was accepted. It was concluded that the type of professional position did not significantly affect the knowledge of the metric system by dietitians participating in the study. These data were presented in Table XXI.

TABLE XXI

ANALYSIS OF VARIANCE--METRIC COMPREHENSION AND PROFESSIONAL POSITION

Position	Number	Pretest Mean	Pretest s	Pretest F Value	Post-Test Mean	Post-Test s	Post-Test F Value
Clinical	29	40.6522	8.9254	1.236	49.5517	9.6087	0.616
Administrative	8	36.0000	13.2017		52.3750	4.8972	
Consultant	13	43.0000	7.9267		52.8461	8.2143	
Other Positions	18	42.7222	8.0936		50.7222	5.8189	

df = (3, 64)

Membership Route and Knowledge of the Metric System

Hypothesis VIII stated there will be no significant difference in comprehension of the metric system by dietitians and the route used to attain ADA membership. The Analysis of Variance statistical procedure was used to determine if there was a significant difference in knowledge of the metric system and the route used for achieving membership in ADA. The five routes for achieving membership were combined because of small numbers in some of the groups. The result was two groups (dietetic internship and all other routes).

When the pretest means of the two membership route groups were combined the F value was .0705 and the post-test comparison of the two membership groups resulted in an F value of .075. The critical F value, for the degrees of freedom (1, 65) at the .05 level of significance, was 3.99. The F values of both the pretest and the post-test were less than the critical F value. This indicated there was no significant difference between the means of the pretest groups and between the means of the post-test groups by route of ADA membership. Therefore, Hypothesis VIII, there will be no significant difference in comprehension of the metric system by dietitians and the route to attain ADA membership, was accepted. The researcher concluded that route for achieving membership did not significantly affect knowledge of the metric system by the participating dietitians. These data were presented in Table XXXII.

TABLE XXII

ANALYSIS OF VARIANCE--METRIC COMPREHENSION AND MEMBERSHIP ROUTE

		Pretest			Post-Test		
Route	Number	Mean	s	F Value	Mean	s	F Value
Internship	56	41.5351	9.3962	0.705	50.9464	8.3130	0.075
Other Routes	12	39.0833	8.0392				

df = (1, 66)

Highest Degree and Knowledge of the Metric System

Hypothesis IX stated there will be no significant difference in comprehension of the metric system by dietitians and the highest degree held by the participants. The Analysis of Variance statistical procedure was used to determine if there was a significant difference in comprehension of the metric system and the highest degree held by the participants. The three groups were combined to form two groups because of the small numbers in some of the groups. The two groups for this statistical procedure were bachelor's degree and graduate degrees--master's and doctoral degrees.

When the pretest means of the two groups were compared, the F value was 1.298. The post-test means of the two groups (highest degree earned) were compared and the result was an F value of 0.648. The critical F value, for the degrees of freedom (1, 66) at the .05 level of significance, was 3.99. The F values for both the pretest and post-test were less than the critical F value. This indicated there was no significant difference between the means of the pretest groups and between the means of the post-test groups by highest degree held. Therefore, Hypothesis IX, there will be no significant difference in comprehension of the metric system by dietitians and the highest degree held by the participant, was accepted. The researcher concluded that the degree held did not significantly affect knowledge of the metric system by participating dietitians. These data were presented in Table XXIII.

TABLE XXIII

ANALYSIS OF VARIANCE--HIGHEST DEGREE AND METRIC CONVERSION

Degree	Number	Pretest Mean	Pretest s	Pretest F Value	Post-Test Mean	Post-Test s	Post-Test F Value
Bachelor's	43	40.1395	9.3696	1.298	51.4186	7.7066	0.648
Master's and Doctoral	25	42.7600	8.7335		49.8000	8.4705	

df = (1, 66)

Undergraduate Grade-Point-Average and Metric Knowledge Correlation

The Pearson Product-Moment Correlation was used to determine if there was a significant difference between undergraduate grade-point-average and metric comprehension. Hypothesis X stated there will be no significant relationship in comprehension of the metric system by dietitians and the participants undergraduate grade-point-average. The undergraduate grade-point-average of participants was correlated with the pretests and post-tests of the participants and these data were presented in Table XLIII, Appendix G.

The correlation coefficient for the .05 level of significance with 65 degrees of freedom was .250 (Popham, 1967). The undergraduate grade-point-average was correlated with the pretest and an r of 0.3266 resulted and a post-test r of 0.1142. The correlation between the undergraduate grade-point-average and the pretest was significant because the r value was greater than the correlation coefficient for the .05 level of significance (.250). The correlation between the undergraduate grade-point-average and the post-test was not significant because the r value was less than the correlation coefficient for the .05 level of significance (.250). Therefore, Hypothesis X, there will be no significant relationship in comprehension of the metric system by dietitians and the participants undergraduate grade-point-average, was not completely accepted. The researcher concluded that undergraduate grade-point-average did not significantly affect knowledge of the metric system after the participants had received instruction, but the pretest indicated a significant relationship between undergraduate grade-point-average and the pretest.

Attitude Toward Conversion and Knowledge of the Metric System

The Pearson Product-Moment Correlation was used to determine if there was a significant relationship between attitude toward metric conversion and comprehension of the metric system. Hypothesis XI stated there will be no significant relationship in comprehension of the metric system by dietitians who favor, those who oppose, and those who are undecided about metric conversion. The participants attitude toward metric conversion was correlated with the pretests and post-tests and these data were presented in Table XLIII, Appendix G.

The correlation coefficient for the .05 level of significance with 65 degrees of freedom was .250 (Popham, 1967). The attitude toward metric conversion was correlated with the pretest with a resulting r of 0.2431 and the post-test r of 0.1332. The correlation coefficient between attitude toward metric conversion and comprehension of the metric system was not significant because the r values were less than the correlation coefficient required for the .05 level of significance (.250). Therefore, Hypothesis XI, there will be no significant relationship in comprehension of the metric system by dietitians who favor, those who oppose, and those who are undecided about metric conversion, was accepted. Even though the relationship of attitude towards the metric system and knowledge of it was not significant at the .05 level, the dietitians in the sample appeared to have a positive attitude toward conversion because the r's were not negative.

Prior Metric Knowledge and Knowledge of the Metric System

The Pearson Product-Moment Correlation was used to determine if there was a significant relationship between prior knowledge of the metric system and comprehension of the metric system. Hypothesis XII stated there will be no significant relationship in comprehension of the metric system by dietitians who have a workable knowledge of the metric system and those who do not have a workable knowledge. The participants prior metric knowledge was correlated with the pretests and post-tests and these data were presented in Table XLIII, Appendix G.

The correlation coefficient for the .05 level of significance with 65 degrees of freedom was .250 (Popham, 1967). Prior knowledge of the metric system was correlated with the pretest score and the resulting r was -0.3212 and prior knowledge was correlated with the post-test score and the resulting r value was -0.0409. The correlation between the pretest and prior knowledge of the metric system was statistically significant at the .05 level and the direction was negative. The post-test and prior knowledge of the metric system of the participants was not significant because the r value was less than the correlation coefficient for the .05 level of significance (.250). Therefore, Hypothesis XII, there will be no significant relationship in comprehension of the metric system by dietitians who have a workable knowledge of the metric system and those who do not have a workable knowledge, was not completely accepted. The researcher concluded that the participants were unable to accurately evaluate the perceived knowledge they possessed of the metric system and this resulted in the negative correlations between prior knowledge of the metric system and the pretests and post-tests.

Method of Acquired Knowledge and Knowledge of the Metric System

Hypothesis XIII stated there will be no significant difference in comprehension of the metric system by dietitians and how the participants acquired a workable knowledge of the metric system. The Analysis of Variance statistical procedure was used to analyze the method of acquiring prior knowledge of the metric system and comprehension of the metric system of the three groups. The five methods of instruction were combined to form two categories because of the small numbers in some of the groups. The two categories for this statistical procedure were formal instruction and self-taught.

When the pretest means of the two groups were compared, the resulting F value was 1.480. The post-test means of the two groups were compared and the result was an F value of 0.4217. The critical F value for 1 and 66 degrees of freedom at the .05 level of significance was 3.999. The F values of both the pretest and post-test were less than the critical F value. This indicated there was no significant difference between the means of the pretest groups and between the means of the post-test groups when methods of acquiring knowledge were compared. Therefore, Hypothesis XIII, there will be no significant difference in comprehension of the metric system by dietitians and how the participants acquired a workable knowledge of the metric system, was accepted. The researcher concluded that the method of gaining knowledge of the metric system prior to the study did not significantly affect knowledge of the metric system by the participating dietitians. These data were presented in Table XXIV.

TABLE XXIV

ANALYSIS OF VARIANCE--ACQUIRED KNOWLEDGE AND METRIC COMPREHENSION

		Pretest			Post-Test		
Instruction	Number	Mean	s	F Value	Mean	s	F Value
Formal Instruction	10	43.3333	6.5000	1.480	49.2222	9.3512	0.4217
Self-Taught	17	46.4118	5.9483		51.8823	7.0523	

df = (1, 66)

Preferred Method of Instruction and Knowledge of the Metric System

Hypothesis XIV stated there will be no significant difference in comprehension of the metric system by dietitians and the method preferred for learning the metric system. The Analysis of Variance statistical procedure was used to analyze the method preferred for learning the metric system and comprehension of the metric system. The five methods of instruction were combined to form three categories for this statistical procedure because of the small numbers in some categories. The three categories were the workshop, programmed instruction, and other types of instruction.

When the pretest means of the three groups were compared, the F value was .072. The post-test means of the three groups were compared and the result was an F value of 1.784. The critical F value for 3 and 65 degrees of freedom was 3.14. The F values for both the pretest group and the post-test group were less than the critical F value. This indicated there was no significant difference between the means of the pretest groups and between the means of the post-test groups when determined by preferred method of instruction. Therefore, Hypothesis XIV, there will be no significant difference in comprehension of the metric system and the method preferred for learning the metric system, was accepted. The researcher concluded that the method preferred for learning the metric system did not significantly affect knowledge of the metric system by the participating dietitians. These data were presented in Table XXV.

Available Measures and Knowledge of the Metric System

The Pearson Product-Moment Correlation was used to determine if there was a significant relationship between having metric measures available to use and comprehension of the metric system. Hypothesis XV stated there will be no significant relationship in comprehension of the metric system by dietitians owning or having available metric measuring equipment for use and dietitians not having available metric measures. Available metric measures was correlated with the pretests and post-tests of the participants and these data were presented in Table XLIII, Appendix G.

TABLE XXV

ANALYSIS OF VARIANCE--PREFERRED INSTRUCTION AND METRIC COMPREHENSION

Instruction	Number	Pretest Mean	Pretest s	Pretest F Value	Post-Test Mean	Post-Test s	Post-Test F Value
Workshop	26	41.5000	10.9809	0.072	49.5000	9.4202	1.784
Programmed	23	40.5217	9.1893		53.3478	6.5478	
Other Instruction	19	41.2632	6.4191		49.5789	6.9707	

df = (3, 65)

The correlation coefficient for the .05 level of significance with 65 degrees of freedom was .250 (Popham, 1967). Available metric measures was correlated with the pretest scores and the resulting r value was -0.3269 and this value was significantly related (in the negative direction) to the availability of metric measures.

Available metric measures was correlated with the post-test scores and the resulting r value was -0.0559; this value was not significant at the .05 level (.250). Therefore, Hypothesis XV, there will be no significant relationship in comprehension of the metric system by dietitians owning or having available metric measuring equipment for use and those not owning or having available metric measuring equipment for use, was not completely accepted because there was a significant difference (in the negative direction) between the pretests and the metric measures, but not the post-tests and metric measures. The researcher concluded that having metric measures available for use does not mean they are used to learn the metric system.

Number of Metric Measures and Knowledge of the Metric System

The Pearson Product-Moment Correlation was used to determine if there was a significant relationship between the number of available metric measures for use and comprehension of the metric system. Hypothesis XVI stated there will be no significant relationship in comprehension of the metric system by dietitians and the number of metric measures they have available for use. The number of metric measures was correlated with the pretests and post-tests of the participants and these data were presented in Table XLIII, Appendix G.

The correlation coefficient for the .05 level of significance with 65 degrees of freedom was .250 (Popham, 1967). The number of metric measures was correlated with the pretest scores and the resulting r value was -0.3237; this was statistically significant (in the negative direction) because the r value was greater than the correlation coefficient needed for being significant at the .05 level (.250).

The number of metric measures was correlated with the post-test scores and the resulting r value was -0.1188. This was not significant because the r value was less than that required to be significant at the .05 level (.250). Therefore, Hypothesis XVI, there will be no significant relationship in comprehension of the metric system by dietitians and the number of metric measures they have available for use, was not completely accepted because there was a negative relationship that was significant between the number of metric measures and the pretest scores. The researcher concluded that the number of available metric measures does not mean they are being used and affecting the knowledge of the metric system.

Use of Metric Measures and Knowledge of the Metric System

Hypothesis XVII stated there will be no significant difference in comprehension of the metric system of measurement by dietitians who often use, sometimes use, and never use metric measures. The Analysis of Variance statistical procedure was used to analyze the frequency of use of metric measures to determine if there was a significant difference in comprehension of the metric system and the use of metric measures.

The F value that resulted when comparing the means of the pretest groups was .502 and .6679 was the F value that resulted when the means of the post-test groups were compared. The critical F value at the .05 level of significance with 2 and 65 degrees of freedom was 3.14. Both of the F values were less than the critical F value and this indicated there was no significant difference between the means of the pretest groups and between the means of the post-test groups as determined by frequency of use of metric measures. Hypothesis XVII stated there will be no significant difference in comprehension of the metric system of measurement by dietitians who often use, sometimes use, and never use metric measures, was accepted because there was no significant difference between the means of the groups for the pretests or post-tests. The researcher concluded that using metric measures had no significant influence on knowledge of the metric system by the participants. These data were presented in Table XXVI.

TABLE XXVI

ANALYSIS OF VARIANCE--METRIC COMPREHENSION AND USE OF METRIC MEASURES

Frequency of Use	Number	Pretest			Post-Test		
		Mean	s	F Value	Mean	s	F Value
Often Uses	3	46.000	7.3485	.502	50.33	2.080	.6679
Sometimes Uses	29	44.448	8.9598		52.035	7.4598	
Never Uses	36	38.072	11.382		49.75	3.15	

General Conclusions

Objective one of this experimental study was to investigate two strategies for teaching dietitians metric system information. The participants were divided into three groups: those receiving traditional lecture instruction (Group I); those receiving programmed instruction (Group II); and those of the control group (Group III). Equivalent forms of a pretest and a post-test were used to evaluate gain in metric knowledge after the participants received instruction. There was no significant difference between the means of the three groups for the pretest; therefore, Hypothesis I was accepted and the researcher concluded that the three groups were from the same population. Post-test statistical analysis indicated a significant difference existed between the means of the three groups and this difference was between the groups receiving instruction and those of the control group. It was concluded that the two teaching strategies were equally effective in increasing the participants knowledge of the metric system; therefore, Hypothesis II was not accepted.

The second part of objective one was to determine if a significant difference existed between the means of the three groups in each of the nine sections of the pretest scores and each of the nine sections of the post-test scores. Hypotheses III and IV were not completely accepted because there was a significant difference between the means of the three groups on two sections of the pretest scores and a significant difference between the means of the three groups for eight sections of the post-test scores. Group I had lower means for two sections of the pretest and the researcher concluded this caused the significant difference between the means of the two sections. There was a significant difference between the means of Group I and Group III for seven sections of the post-test; there was a significant difference for the means of Group II and Group III for eight sections of the post-test; there was no significant difference between the means of Group I and Group II for eight sections of the post-test; and there was no significant difference between the means of the three groups for one section of the post-test (Decimal Review). It was concluded that programmed instruction increased the participants knowledge of the metric system in eight sections of the post-test and the traditional lecture method of instruction increased the participants knowledge of the metric system in seven sections of the post-test.

The second objective of this study was to determine if intervening variables (professional data and attitude toward metric conversion) significantly affected the participants knowledge of the metric system. Nine of the intervening variables analyzed had no significant effect on knowledge of the metric system of dietitians participating in the study; therefore, Hypotheses V, VI, VII, VIII, IX, XI, XIII, XIV, and XVII were accepted. Years of membership, number of professional meetings attended, professional position, route for achieving membership, highest degree held, attitude toward metric conversion, how metric knowledge was acquired, method of instruction preferred, and use of metric measures had no significant effect on the participants knowledge of the metric system; therefore, these variables probably do not need consideration in future metric studies involving metrication.

The remaining hypotheses (Hypotheses X, XII, XV and XVI), used to determine if intervening variables affected knowledge of the metric system, were not completely accepted. There was a significant difference between the means of the groups when undergraduate grade-point-average, prior knowledge of the metric sytem, available metric measures, and the number of metric measures were compared with the pretest scores. However, when these intervening variables were compared with post-test scores, the results were not significant. The researcher concluded that these variables did not significantly affect gain in knowledge of the metric system by participating dietitians.

Recommendations for Metric Education for Dietitians

The researcher evaluated two instructional programs for teaching dietitians the metric system. The results of the study formed the basis for the following recommendations. It was recommended:

1. that programmed instruction or workshops in the metric system be made available immediately for dietitians. This study indicated a need for knowledge of the metric system by dietitians.
2. that national, state and district associations actively support metric educational programs that will prepare dietitians for conversion to the metric system of measurement.
3. that directors of all educational programs in the dietetic continuum (dietitian to dietetic aide) include the metric system as part of their curriculum.
4. that standards be developed and enforced for professional publications in the food, nutrition and institution administration area requiring the metric system be used for all measurements.

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APPENDIXES

APPENDIX A

PROFESSIONAL-METRIC QUESTIONNAIRE

Oklahoma State University

Department of Food, Nutrition and Institution Administration

STILLWATER, OKLAHOMA 74074
(405) 624-5039

September 1, 1977

Dear Fellow Dietitian:

The American Dietetic Association House of Delegates passed a resolution in October 1976 that states the association will actively work toward metrication in the United States. As members of the dietetics profession we will be involved with helping people learn the metric system of measurement. As a registered dietitian and doctoral student at Oklahoma State University, I am conducting a study to determine which of two teaching strategies, programmed instruction or lecture method, better equips dietitians with a basic knowledge of the metric system.

This research will involve dietitians in the state of Oklahoma and your assistance is needed. If you are willing to participate in this study complete the enclosed Professional-Metric Questionnaire and Metric Skills I. At a later date all participants will be asked to complete Metric Skills II so the effects of the teaching strategies can be analyzed.

If you would like a brief summary of the findings of this research when it is completed, I will be happy to send it to you if this is indicated on the enclosed postcard. This summary should be available by August 1978.

I do appreciate your willingness to participate in this study. Please return the instruments in the enclosed, self-addressed stamped envelope by September 15, 1977. Thank you for your cooperation.

Yours very truly,

Shirley Gibbs

Shirley Gibbs, Doctoral Candidate

Anna Gorman

Dr. Anna Gorman, Adviser

Esther Winterfeldt

Dr. Esther Winterfeldt, Adviser

OKLAHOMA STATE UNIVERSITY

Division of Home Economics

Department of Food, Nutrition and Institution Administration

NOTICE of Graduate Class offered Fall Semester, 1977.

To: Dietitians, Graduate Students, Others Interested

Course: FNIA 4850. Metric Education for Dietitians. One hour graduate and ADA Continuing Education credit.

Dates: October 14 and October 21, 1977.

Class will meet in Home Economics East 102 from 9:00 a.m. to 4:00 p.m. and Independent Study time will be assigned.

Instructor: Shirley Gibbs

Students will be able to enroll the first class meeting. Please direct all questions to the FNIA Department, Room 413, Home Economics West, Oklahoma State University, phone number: 405-624-5039.

In this envelope, besides the announcement of the metric class, there is a Questionnaire and a Metric Skills I (pretest). I need all of you to complete these items and return them to me using the enclosed self-addressed, stamped envelope. Will you notice on the questionnaire that there is a place for you to check if you are planning to attend the two class sessions or a place to check if you are willing to take and complete the programmed instruction. If you are not planning to participate in either of these activities, I hope you will be willing to complete the Questionnaire, complete Metric Skills I (pretest), and Metric Skills II (post-test). Your help is greatly appreciated for these materials are all a part of my dissertation effort for earning a doctoral degree.

Code Number: ____________________
Name: ______________________

PROFESSIONAL-METRIC QUESTIONNAIRE

Directions: This questionnaire has been designed so that you may indicate the response of your choice by a check (√) in the space provided. Please answer all of the following questions. Your identity and answers will be kept strictly confidential.

1. What category describes your professional classification?

____a. Registered dietitian
____b. ADA dietitian
____c. Not ADA member
____d. Inactive member

2. How long have you been a member of the American Dietetics Association?

____a. 0-2 years
____b. 3-5 years
____c. 6-8 years
____d. 9-11 years
____e. 12-14 years
____f. Over 14 years

3. Which professional meetings have you attended during the past year? (Check all that are applicable.)

____a. National dietetics meeting
____b. Fall dietetics meeting (state)
____c. Spring dietetics meeting (state)
____d. District dietetics meeting
____e. University or extension class
____f. Tapes or educational material approved by ADA
____g. International Congress of Dietetics

4. Are you currently professionally employed in the dietetics field?

____a. Yes
____b. No

5. If your answer to question number 4 is yes, which category or categories describes your present position?

____a. Clinical dietititan
____b. Administrative dietitian
____c. Consultant dietitian
____d. Teaching dietitian
____e. Research dietitian
____f. Private practice
____g. Other (specify) ______________________

6. Which route did you use to attain ADA membership?

____a. Dietetic internship
____b. Traineeship
____c. Preplanned work experience
____d. Degree plus work experience

7. What is the highest degree held?

____a. Bachelor's degree
____b. Master's degree
____c. Specialist degree
____d. Doctoral degree

8. What was your undergraduate grade-point-average on a 4.0 scale?

____a. 1.5 to 2.5
____b. 2.6 to 3.5
____c. 3.6 to 4.0

9. What is your attitude toward metric conversion?

____a. Support metric conversion
____b. Oppose metric conversion
____c. Undecided about metric conversion

10. Do you have a workable knowledge of the metric system of measurement?

____a. Yes
____b. No

11. If the answer to question 10 is yes, how did you secure this knowledge?

____a. Workshop
____b. Programmed instruction
____c. University or extension class
____d. Telelecture
____e. Other (Specify) ____________________

12. What method of instruction for metric education would you most prefer?

____a. Workshop
____b. Programmed instruction
____c. University or extension class
____d. Telelecture
____e. Other (specify) ____________________

13. Do you own or have available for your use any metric measuring equipment?

____a. Yes
____b. No

14. If the answer to question 13 is yes, what are they?

____a. Measuring cup
____b. Measuring spoons
____c. Thermometer
____d. Scales
____E. Other (specify) ____________________

15. If the answer to question 13 is yes, do you use them?

____a. Often
____b. Sometimes
____c. Never

16. Will you participate in the metric study by selecting one of the options?

____a. Attending the workshop
____b. Completing the programmed instruction
____c. Completing the questionnaire, Metric Skills I, and Metric Skills II

Thank you for your cooperation and assistance.

APPENDIX B

METRIC SKILLS I

No. ______________________________

METRIC SKILLS I

Directions: The following are multiple choice items. Choose the best answer. Write the letter of your response in the blank to the left of the statement. Please do not use any assistance or aids in measuring as this would affect the results of the study.

______1. The United States is undergoing conversion to the metric system of measurement. One principle that applies to the changeover is __________.

A. change to the metric system will be made immediately
B. the government will pay the cost of conversion
C. the changeover is not mandatory
D. initiative and planning rests in the hands of the government

______2. The metric system is based on the __________ system.

A. number
B. decimal
C. prefix
D. suffix

______3. The prefix that means ten times is __________.

A. kilo
B. deka
C. deci
D. centi

______4. The prefix that means 10^3 is __________.

A. centi
B. kilo
C. hecto
D. deka

______5. The prefix deci means __________.

A. 1/10
B. 1/100
C. 1/1000
D. 1

______6. The prefix centi means ___________.

A. 1/10
B. 1/100
C. 1/1000
D. 1

______7. Subtract 6.122 from 24.24 and the answer is ____________.

A. 36.88
B. 18.118
C. 181.18
D. 3.688

______8. Multiply (34.39) (0.21) and the answer is ___________.

A. 277.19
B. 72.219
C. 0.72219
D. 7.2219

______9. Divide 981.1308 by 3.27 and the answer is ___________.

A. 3.0004
B. 300.04
C. 30.004
D. 0.30004

_____10. Round off 1.0973 to the nearest two decimal places and the answer is __________.

A. 1.09
B. 1.10
C. 1.19
D. 1.00

_____11. When the numbers 0.16, 0.197, and 0.2207 are added together, the answer is ________.

A. 0.5777
B. 0.2420
C. 57.77
D. 24.20

_____12. The basic metric measurement for length is ___________.

A. meter
B. kilometer
C. centimeter
D. millimeter

_____13. The average width of a fingernail is approximately _________.

A. 1 centimeter
B. 1 meter
C. 1 decimeter
D. 1 millimeter

_____14. The approximate span of your hand from the end of your thumb to the end of the little finger is ___________.

A. 1 meter
B. 20 decimeters
C. 20 centimeters
D. 20 millimeters

_____15. A new pencil is about _____________ long.

A. 15 centimeters
B. 1 decimeter
C. 1 meter
D. 15 millimeters

_____16. There are ___________ centimeters in a meter.

A. 0.001
B. 0.01
C. 1000
D. 100

_____17. The correct symbol for centimeter is ____________.

A. Cm
B. Cm.
C. cm
D. cm.

_____18. The smallest division of space on the metric ruler is the _____________.

A. millimeter
B. centimeter
C. decimeter
D. dekameter

_____19. One cubic centimeter of cold water weighs _____________.

A. 1 gram
B. 1 kilogram
C. 1 centigram
D. 1 milligram

_____20. When you travel 25.8 kilometers this is the same as __________ decimeters.

A. 0.258
B. 2 580
C. 25 800
D. 258 000

_____21. Your waist measurement is 92 centimeters or ____________ dekameters.

A. 9.2
B. 0.092
C. 0.92
D. 920

_____22. The liter can be divided into ten equal parts called _________.

A. centiliters
B. deciliters
C. dekaliters
D. milliliters

_____23. The correct symbol for deciliter is _____________.

A. dl
B. D^{l}.
C. da^{l}
D. Da^{l}

_____24. There are _____________ centiliters in a deciliter.

A. 1
B. 10
C. 100
D. 1000

_____25. A container has a volume of one cubic centimeter or __________.

A. 1 liter
B. 1 centiliter
C. 1 kiloliter
D. 1 milliliter

_____26. One milliliter of cold water weighs approximately __________.

A. 1 gram
B. 1 kilogram
C. 1 centigram
D. 1 milligram

_____27. When 247 milliliters is changed to liters, the amount is __________.

A. 24.7
B. 2.47
C. 0.247
D. 0.0247

_____28. One tablespoon is the same as __________ milliliters.

A. 5
B. 10
C. 15
D. 30

_____29. The weight of one liter of cold water is about __________.

A. 1.0 milliliter
B. 10.0 kilograms
C. 100.0 kilograms
D. 1000.0 grams

_____30. A recipe calls for 250 milliliters of milk or __________ liters.

A. 25.0
B. 2.50
C. 0.250
D. 0.0250

_____31. When you change 0.580 centimeters to liters the answer is __________.

A. 05.80
B. 0.0580
C. 0.005 80
D. 0.000 580

_____32. The correct symbol for dekagram is __________.

A. dg
B. Dg
C. Dag
D. dag

_____33. When 550 decigrams is changed to kilograms the answer is __________.

A. 0.0550
B. 0.550
C. 5.50
D. 55.0

_____34. To change grams to kilograms move the decimal __________.

A. three places to the right
B. three places to the left
C. two places to the right
D. two places to the left

_____35. A pound of sugar has the approximate weight of _________.

A. 1 kilogram
B. 50 grams
C. 450 grams
D. 250 grams

_____36. Nutrition labeling on food containers is listed in __________.

A. grams
B. ounces
C. pounds
D. liters

_____37. A gram is equal to the approximate weight of a _________.

A. pound
B. paperclip
C. pencil
D. cracker

_____38. A young female adult should weight approximately _________.

A. 1 milligram
B. 100 kilograms
C. 1 kilogram
D. 55 kilograms

_____39. The approximate number of 4 ounce servings you can expect from one kilogram of cooked roast pork is __________.

A. 1
B. 3
C. 10
D. 15

_____40. When 2.84 grams and 250 milligrams are added, the sum is ___________ milligrams.

A. 3.09
B. 0.309
C. 30.9
D. 3090

_____41. A recipe calls for 0.028 kilograms of flour or __________ grams.

A. 280
B. 2800
C. 28
D. 0.000 028

_____42. The normal human body temperature is ___________ degrees Celsius.

A. 37
B. 98.6
C. 75
D. 60

_____43. Minus 40 degrees Fahrenheit is the same as _________ degrees Celsius.

A. 0
B. -20
C. -30
D. -40

_____44. For every nine degrees a Fahrenheit temperature rises, a Celsius temperature rises _________ degrees.

A. 3
B. 5
C. 7
D. 9

_____45. A thermometer which measures temperatures from 35 degrees Celsius to 42 degrees Celsius would likely be used for _______.

A. indoor-outdoor thermometer
B. oral (body) thermometer
C. oven thermometer
D. indoor thermometer

_____46. The temperature on the hot water tank is 140 degrees Fahrenheit or __________ degrees Celsius.

A. 60
B. 80
C. 100
D. 120

_____47. If the doctor says you have a temperature of 37 degrees Celsius, then it is time to ____________.

A. stay in bed
B. go to work
C. take aspirin
D. seek further medical assistance

_____48. The reference male as used for the Recommended Dietary Allowances, would need approximately ______________ kilojoules per day.

A. 11 500
B. 1500
C. 1000
D. 10 000

_____49. The American Heart Association recommends that no more than 10 percent of total energy requirements should come from saturated fat. For the reference male this would be _________ kilojoules.

A. 1150
B. 150
C. 100
D. 1000

_____50. One gram of fat provides nine calories or ____________ kilojoules.

A. 17
B. 1.7
C. 38
D. 3.8

_____51. A nine inch round cake pan is approximately __________ centimeters in diameter.

A. 23
B. 20
C. 15
D. 25

_____52. One ounce equals __________ grams.

A. 28.35
B. 2.835
C. 283.5
D. 0.2835

_____53. You would need approximately __________ liters of punch to serve 200 people (six ounces per serving).

A. 10
B. 8
C. 36
D. 20

_____54. If you purchase six gallons of gas, this is approximately ___________ liters.

A. 6
B. 21
C. 24
D. 12

_____55. One fluid ounce equals ____________ milliliters.

A. 2957
B. 295.7
C. 29.57
D. 2.957

_____56. A small bottle holds 150 cubic centimeters. This is the same as __________ fluid ounces.

A. 30
B. 5
C. 150
D. 0.5

_____57. A one cup customary measuring cup is the same as ___________ milliliters.

A. 250
B. 240
C. 100
D. 120

_____58. The correct use of the period in the metric system of measurement is ___________.

A. use periods after each SI unit symbol
B. never use periods with SI unit symbols
C. use periods only at the end of the sentence
D. use periods with designated SI unit symbols

_____59. Commas are not used with figures representing large amounts because ____________.

A. that is the method in the English system
B. only periods are used
C. the comma is sometimes interpreted as a decimal point
D. a person can interpret the numbers without commas

_____60. When writing numbers and metric symbols the correct method is ___________.

A. no space between number and symbol
B. one space between number and symbol
C. double space between number and symbol
D. the number follows the symbol

APPENDIX C

METRIC SKILLS II

No. ______________________________

METRIC SKILLS II

Directions: The following are multiple choice items. Choose the best answer. Write the letter of your response in the blank to the left of the statement. Please do not use any assistance or aids in answering as this would affect the results of the study.

______1. The metric system originated in ____________.

A. the United States
B. England
C. France
D. Canada

______2. The Metric Conversion Act was signed in ___________.

A. 1971
B. 1975
C. 1968
D. 1795

______3. The prefix for the fraction 1/10 is _____________.

A. centi
B. deka
C. deci
D. milli

______4. The prefix hecto means ______________ times.

A. 100
B. 10
C. 1000
D. 1

______5. The prefix that means a thousand times is ____________.

A. centi
B. milli
C. kilo
D. hecto

______6. The prefix deci means __________.

A. 1/10
B. 1/100
C. 1/1000
D. 1

______7. When you add 256.01, 1.0003, and 73.73 the total is __________.

A. 772.904
B. 330.7403
C. 1093.340
D. 77.2904

______8. Subtract .0009 from 7.35 and the answer is ___________.

A. 7.2600
B. 734.91
C. 7.26
D. 7.3491

______9. Multiply (75.1)(.405) and the answer is ____________.

A. 33.795
B. 3.3795
C. 30.4155
D. 304.155

_____10. Divide 7.4148 by 50.1 and the answer is ____________.

A. 0.148
B. 0.0148
C. 1.48
D. 0.00148

_____11. Round off 2.30374 to the nearest three decimal places and the answer is ____________.

A. 2.303
B. 2.304
C. 230.374
D. 2303

_____12. The correct symbol for millimeter is ____________.

A. Mm
B. Mm.
C. mm
D. mm.

_____13. When 5.7 hectometers is changed to centimeters, the answer is __________ centimeters.

A. 570
B. 0.057
C. 5700
D. 57 000

_____14. A kilometer is equal to __________ meter(s).

A. 1
B. 10
C. 100
D. 1000

_____15. To change from kilometer to decimeter move the decimal point __________.

A. two places to the right
B. two places to the left
C. four places to the right
D. four places to the left

_____16. One hundred centimeters is equal to __________ meter(s).

A. 1
B. 10
C. 100
D. 1000

_____17. One meter is equal to __________ millimeters.

A. 1
B. 10
C. 100
D. 1000

_____18. A basketball player is approximately __________ tall.

A. 20 centimeters
B. 35 centimeters
C. 2 meters
D. 1 meter

_____19. There are __________ meters in a kilometer.

A. 1
B. 10
C. 100
D. 1000

_____20. One dekameter equals __________ meters.

A. 1
B. 10
C. 100
D. 1000

_____21. The distance from Oklahoma City to a suburb is ten miles. The distance in kilometers is approximately ____________.

A. 10
B. 16
C. 6
D. 20

_____22. The correct symbol for 100 kilograms is 100 ____________.

A. Kgs
B. Kg
C. kgs
D. kg

_____23. A gram is equal to __________ decigrams.

A. 1
B. 10
C. 100
D. 1000

_____24. A gram is equal to __________ centigrams.

A. 1
B. 10
C. 100
D. 1000

_____25. A milligram is ____________ of a gram.

A. 1/10
B. 1/100
C. 1/1000
D. 1/10 000

_____26. When 2.42 kilograms and 370 grams are added the answer is ____________ grams.

A. 2.79
B. 613
C. 2790
D. 372.42

_____27. We can say that 55 grams is the same as ____________ milligrams.

A. 0.055
B. 550
C. 5500
D. 55 000

_____28. The correct symbol for gram is ____________.

A. g
B. g.
C. Gm
D. G

_____29. When 187 centigrams is converted to dekagrams the answer is __________ dekagrams.

A. 187
B. 18.7
C. 1.87
D. 0.187

_____30. One hectogram is equal to ____________ centigrams.

A. 100
B. 1000
C. 10 000
D. 10

_____31. The correct symbol for kilogram is ___________.

A. Kg
B. Kg.
C. kg
D. kg.

_____32. A liter is slightly larger than a ___________.

A. pint
B. quart
C. gallon
D. cup

_____33. One liter is equal to ____________ milliliter(s).

A. 1
B. 10
C. 100
D. 1000

_____34. A dekaliter is __________ times greater than a liter.

A. 1
B. 10
C. 100
D. 1000

_____35. To change milliliters to liters move the decimal point ____________.

A. one place to the left
B. one place to the right
C. three places to the left
D. three places to the right

_____36. To change hectoliters to kiloliters, move the decimal point ____________.

A. one place to the left
B. one place to the right
C. two places to the left
D. two places to the right

_____37. One milliliter is equivalent to ___________.

A. one square milliliter
B. one centimeter squared
C. one cubic millimeter
D. one cubic centimeter

_____38. For commercial food service operattions the recommended units for measuring liquids is ___________.

A. liter and milliliter
B. centigram and gram
C. meter and centimeter
D. liter and centiliter

_____39. The approximate weight of one liter of cold water is _________.

A. 1 gram
B. 2.2 grams
C. 500 grams
D. 1 kilogram

_____40. We can say 2.50 kiloliters or ____________ centiliters.

A. 0.0025
B. 250
C. 25 000
D. 250 000

_____41. You need to purchase 30 liters of milk or ____________ centiliters of milk.

A. 0.030
B. 300
C. 3000
D. 30 000

_____42. On a cold day the temperature outside would be __________ degrees Celsius.

A. 32
B. 0
C. 20
D. 28

_____43. To bake most cakes the temperature should be ___________ degrees Celsius.

A. 400
B. 150
C. 350
D. 180

_____44. Water boils at ___________ degrees Celsius.

A. 212
B. 100
C. 0
D. 32

_____45. The temperature for an institutional freezer should be approximately ______________ degrees Celsius.

A. -40
B. -30
C. -20
D. 0

_____46. If the temperature is 20 degrees Celsius it would be a ___________ day.

A. hot
B. cold
C. cool
D. humid

_____47. A dry storage area temperature should be approximately ________ degrees Celsius.

A. 40
B. 20
C. 100
D. 70

_____48. A gram of carbohydrate provides four calories or _____________ kilojoules.

A. 17
B. 1.7
C. 38
D. 3.8

_____49. The reference female as used for the Recommended Dietary Allowances, would need about _____________ kilojoules per day.

A. 8372
B. 837.2
C. 2000
D. 1000

_____50. For this reference person, the percentage of fat recommended by the American Heart Association would provide __________ kilojoules per day.

A. 700
B. 2940
C. 294.4
D. 2000

_____51. An eight inch pie pan is approximately ___________ centimeters in diameter.

A. 23
B. 20
C. 15
D. 25

_____52. A recipe requires 500 pounds of roast beef or ___________ kilograms.

A. 250
B. 227
C. 1000
D. 1200

_____53. A four ounce portion of roast turkey weighs ___________ grams.

A. 113.4
B. 1134.0
C. 11.34
D. 1.134

_____54. A four ounce bottle of flavoring contains __________ milli-liters.

A. 118.3
B. 1183.0
C. 11.83
D. 1.183

_____55. One tablespoon equals ___________ milliliters.

A. 5
B. 10
C. 15
D. 25

_____56. The temperature recommended for homes during the energy crisis by President Carter was _________ degrees Celsius.

A. 20
B. 30
C. 40
D. 65

_____57. A hot oven for baking pizza would be approximately _________ degrees Celsius.

A. 550
B. 400
C. 290
D. 150

_____58. The correct form for writing ten thousand when using the metric system is ____________.

A. 10,000
B. 10 000
C. 10000
D. 10.000

_____59. When using metric symbols it is correct to ___________.

A. write symbols using only capital letters
B. use a period after the symbol
C. leave no space between number and symbol
D. use a space or hypen when writing a compound

_____60. Rounding of results when converting to metric units _________.

A. is never done
B. is done for technical use
C. is done for applications in home economics
D. is done only to the nearest whole number

APPENDIX D

SAMPLE OF LECTURE MATERIALS, PART OF

UNIT I--INTRODUCTION TO THE

METRIC SYSTEM

INTRODUCTION TO THE METRIC SYSTEM

Objectives (transparency)

When you have completed this unit you will be able to:

1. define metric system and measurement;
2. identify the metric system that will be used in the United States;
3. list ways the metric system is currently being used in the United States;
4. list some major events in the development of the metric system in the United States;
5. identify advantages of metric converstion for the United States;
6. identify disadvantages of metric conversion for the United States.

One of the main problems in converting to the metric system is one of educating the public. Those responsible for educational policies and procedures need to determine the best method or methods of teaching the metric system to Americans. Estimates of the amount of training needed to learn the metric system vary. During the 1970 Education Conference of the Metric Study, John F. Kourmadas of the National Association of Secondary School Principals estimated that 8 to 15 hours of inservice training would be needed. Joseph R. Caravella reports that preliminary results from a pilot metric education program in Hawaii confirmed the Metric Study's estimate that training can be done in 10 to 15 hours. This program was designed to provide dietitians with information needed to use the metric system and requires approximately 15 hours of study.

A question you may be asking is: "What is the metric system and why is it better than our present system of weights and measures?" This program should answer this question and when you have completed the program you should have the answer to the question.

The Metric System

The metric system is a highly organized system of measurement in which the units of length, area, volume, capacity, and mass are related. It has a close relationship to our decimal system of numeration since the units are expressed in powers of 10. This makes it relatively easy to shift from one unit to another by shifting the decimal point. Schimizzi (1975, p. 4) says "the metric system is sanity, is teachable, and is learnable. It is a permanent, accurate universally understood system of standards." In summary we can say the metric system is a decimal system (transparency).

A Short History of the Metric System

The idea that weights and measures were among the earliest devices invented by mankind is generally conceded by historians of metrology. They base their conclusions on the fact that archaeological records of the most ancient civilizations exhibit well-developed concepts of weight and measurement.

A need for uniform weights and measures exists in any country if people trade with each other or with other countries. Two important conditions of any measurement system are that units be convenient and that they be <u>consistent</u>. Of all the measurement systems, the metric system satisfies these two conditions best (transparency).

As commerce developed between the 13 colonies, a need for uniform weights and measures was created in the United States. This need led to the clauses in the Articles of Confederation and the Constitution of the United States giving power to Congress to fix standards of weights and measures. This was the beginning of serious deliberations with regard to fixing of weights and measures in the United States.

The development of a metric system of measurement by France and the beginning of debates in the United States, with regard to fixing a standard of weights and measures, both occurred in the year 1790. The "Systeme International de'Unites" or International System of Units (SI) was officially adopted by France in 1795. SI is the international abbreviation for the metric system and is the official system of metric measurement that will be used by the United States (transparency).

PRACTICE PROBLEMS

(One for Each Participant)

Answer the following items by completing the blanks.

1. The amount of training needed to learn the metric system is approximately ______ to ______ hours.
2. The metric system can briefly be defined as a ____________ system.
3. We know that weights and measures were among the earliest devices developed by mankind because ______________________________.
4. Two important conditions of any measuring system are ______________ and ____________.
5. A need for uniform weights and measures in the United States was created by ______________.
6. Uniform weights and measures in the United States are determined by ________________.
7. The metric system was developed by _____________.
8. The metric system was developed in the year __________.
9. The metric system that will be used in the United States is called _____________.
10. The international abbreviation for the metric system is __________.

ANSWERS TO ITEMS 1 THROUGH 10

(Transparency)

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1. The amount of training needed to learn the metric system is approximately 8 to 15 hours.
2. The metric system can briefly be defined as a decimal system.
3. We know that weights and measures were among the earliest devices developed by mankind because the most ancient civilizations exhibit well-developed concepts of weight and measurement.
4. Two important conditions of any measuring system are that the units be convenient and that they be consistent.
5. A need for uniform weights and measures in the United States was created by commerce between the 13 colonies.
6. Uniform weights and measures in the United States are determined by Congress.
7. The metric system was developed by France.
8. The metric system was developed in the year 1790.
9. The metric system that will be used in the United States is the International System of Units.
10. The international abbreviation for the metric system is SI.

Progress Toward Conversion

Today more than 90 percent of the world's population uses metric measurement in everyday living. The United States is the last major industrial nation to convert to the metric system of measurement (transparency). Great Britain began conversion to the metric system in 1965. Australia followed in 1970 and Canada in 1971. The United States was isolated--an island in a metric sea. Multinational corporations were forced with the need to use metric as well as customary units, so they began conversion. A further impetus for conversion was the decision, from the nine Common Market Countries, that after April 12, 1978, they would accept no imports unless labeled in metric dimensions.

Each day in the United States, an estimated 20 billion measurements are made. Measurement being defined as assigning a numerical value to some attribute or describing the size of objects in our environment (transparency). The metric system of measurement is much simpler to use than our present system of measurement, but more important it allows us to communicate with the rest of the world. Scientists use the metric system of measurement because it is logical, simple and unified. We count by tens so why not measure by them (transparency).

Discussion about converting to the metric system in the United States is not new. Let's take a look at some major events in the development of the metric system in the United States (transparency).

1790--Thomas Jefferson, the Secretary of State, was assigned by President Washington to prepare a new system of weights and measures for Congress to consider to replace the English system that was being used. Jefferson devised a complete, consistent, wholly decimal system of weights and measures and presented them to Congress, but Congress took no action. His system coincided with the French system in the direct relations of linear, weight, and units of volume and the use of simple decimal arithmetic.

1816--John Quincy Adams, the Secretary of State, was instructed to study the possibility of adopting a national standardized system of weights and measures. Adams reported on the advantages of the metric system, but was reluctant to recommend the immediate conversion to metric because most of the nation's trade was with the nonmetric British Empire. Again Congress took no action, but the debate concerning adoption of a standard for weights and measures continues with varying degrees of intensity for the next 50 years.

1866--Congress made the use of the metric system legal, but not mandatory.

1875--The Treaty of the Meter was signed in Paris by 17 nations and the United States was one of those 17 nations. This treaty endorsed the metric system as the internationally preferred system.

1901--Congress established the National Bureau of Standards. Their first meeting was held in 1905 with the objective of securing uniform laws of weights and measures.

1967--The American Home Economics Association (AHEA) passed a resolution supporting the adoption of the metric system. Doris Hanson, Executive Director of AHEA said, "Many citizens care deeply about our world position and want us to be part of the family of man. To be in step with the language of measurement in a step in that direction."

1968--President Lyndon Johnson signed into law an act providing for a three year program to determine the impact of increasing the use of the metric system in the United States. The results were submitted to Congress in 1971 and the Secretary of Commerce recommended to Congress that the United States change to a predominant use of the metric system. Debate continues with little action until . . .

1975--President Gerald Ford signed the "Metric Conversion Act of 1975" which outlines a 10 year plan for voluntary transition to the metric system.

1976--The American Dietetics Association House of Delegates passed a motion stating that: "The American Dietetics Association actively work toward adoption of metrication in the United States through encouraging the use of metric units on food labels, in nutrition education materials, sponsoring continuing education for members, and to join the American Home Economics Association in their efforts to teach homemakers how to purchase foods for their families using the metric units."

PRACTICE PROBLEMS

(Handout for Each Participant)

Complete the following items by filling in the blanks.

11. Today metric measurement is used by ____________ percent of the world's population.

12. The last major industrial nation to convert to the metric system is __________________.

13. Describing the size of objects in our environment or assigning a numerical value to some attribute is defining ______________.

14. The metric system was first presented to Congress in __________.

15. Congress made the use of the metric system legal, but not mandatory in ____________.

16. The American Home Economics Association passed a resolution supporting the adoption of the metric system in __________.

17. The Metric Conversion Act was passed in __________.

18. The Metric Conversion Act outlines voluntary transition to the metric system will take ____________.

ANSWERS TO ITEMS 11 THROUGH 18

(Transparency)

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11. Today metric measurement is used by 90 percent of the world's population.
12. The last major industrial nation to convert to the metric system is the United States.
13. Describing the size of objects in our environment or assigning a numerical value to some attribute is defining measurement.
14. The metric system was first presented to Congress in 1790.
15. Congress made the use of the metric system legal, but not mandatory in 1866.
16. The American Home Economics Association passed a resolution supporting the adoption of the metric system in 1967.
17. The Metric Conversion Act was passed in 1975.
18. The Metric Conversion Act outlines voluntary transition to the metric system that will take 10 years.

APPENDIX E

SAMPLE OF PROGRAMMED INSTRUCTION

MATERIALS, UNIT II--PREFIXES

PREFIXES

Objectives:

When you have completed this unit you will be able to:

1. identify the four units of the metric system that are most used;
2. state the symbol for each of the four units;
3. state the meaning of each of the four units;
4. list the six prefixes that are most used;
5. identify the symbol for each of the six prefixes;
6. state the meaning of each of the six prefixes.

There are four units of measurement which concern us most in daily living. They are: weight, length, volume and temperature. The basic metric unit of length is the meter, for weight it is the gram, and the liter is for volume. The metric measurement of temperature is the degree Celsius and it is derived from the kelvin scale. Temperature is written as "C" or spoken of as "degree Celsius". The four units of metric measurement, their symbols, and meanings that will be of concern to most people, are presented in Table XXVII.

The meter, the gram, and the liter use prefixes to change the size of units. There are three common metric prefixes for decreasing a measurement by 10 and three common prefixes for increasing the measurement by multiples of 10. There are other prefixes as demonstrated by Table XXVIII, but the prefixes kilo (k), hecto (h), deka (da), deci (d), centi (c), and milli (m) are the ones most used.

The six prefixes, symbols, and meanings that will be of most concern are presented in Table XXIX.

TABLE XXVII

METRIC UNITS

Unit	Symbol	Meaning
meter	m	basic metric unit for length
gram	g	basic metric unit for weight
liter	l	basic metric unit for volume
Celsius	C	basic metric unit for temperature

TABLE XXVIII

METRIC (SI) PREFIXES

Multiplication Factor	Prefix	Symbol	Meaning (in USA)
1 000 000 000 000 000 000 = 10^{18}	exa	E	one quintillion times
1 000 000 000 000 000 = 10^{15}	peta	P	one quadrillion times
1 000 000 000 000 = 10^{12}	tera	T	one trillion times
1 000 000 000 = 10^{9}	giga	G	one billion times
1 000 000 = 10^{6}	mega	M	one million times
1 000 = 10^{3}	kilo	k	one thousand times
100 = 10^{2}	hecto	h	one hundred times
10 = 10^{1}	deka	da	ten times
0.1 = 10^{-1}	deci	d	one tenth of
0.01 = 10^{-2}	centi	c	one hundredth of
0.001 = 10^{-3}	milli	m	one thousandth of
0.000 001 = 10^{-6}	micro		one millionth of
0.000 000 001 = 10^{-9}	nano	n	one billionth of
0.000 000 000 001 = 10^{-12}	pico	p	one trillionth of
0.000 000 000 000 001 = 10^{-15}	femto	f	one quadrillionth of
0.000 000 000 000 000 001 = 10^{-18}	atto	a	one quintillionth of

TABLE XIX

METRIC (SI) PREFIXES

Prefix	Symbol	Multiplication Factor	Meaning
kilo	k	$1\,000 = 10^{3}$	one thousand times
hecto	h	$100 = 10^{2}$	one hundred times
deka	da	$10 = 10^{1}$	ten times
		$1 = 10^{0}$	base unit
deci	d	$0.1 = 10^{-1}$	one tenth of
centi	c	$0.01 = 10^{-2}$	one hundredth of
milli	m	$0.001 = 10^{-3}$	one thousandth of

Each prefix is a multiple or a submultiple of 10. Three of the six prefixes most often used are kilo, centi, and milli. These six prefixes, symbols, and meanings must be memorized. A big step in learning the metric system is learning these six prefixes, their symbols and their meanings.

Answer the following items by filling in the blanks with the appropriate prefix. Do not look back for the answers.

37. 1 000 times = ____________

38. 10^{-2} = _______________

39. 10 times = ______________

40. 10^{-3} = ________________

41. 0.001 = ________________

42. 100 times = ________________

43. 0.01 = ________________

44. 10^{3} = _______________

45. 0.1 = _______________

46. 10^{-1} = _______________

47. 10^{2} = ________________

48. 10^{1} = ________________

The answers to these questions are on the following page.

Answers to items 37 through 48.

37. 1 000 times = kilo

38. 10^{-2} = centi

39. 10 times = deka

40. 10^{-3} = milli

41. 0.001 = milli

42. 100 times = hecto

43. 0.01 = centi

44. 10^{3} = kilo

45. 0.1 = deci

46. 10^{-1} = deci

47. 10^{2} = hecto

48. 10^{1} = deka

If any of your answers are incorrect, erase the incorrect answers, reread the material, and then answer the items correctly.

Answer the following items by writing the correct symbol in each blank. Do not look back for the answers.

49. deci = ____________

50. kilo = ____________

51. milli = ___________

52. deka = ____________

53. centi = ___________

54. hecto = ___________

Answer the following items by writing the correct meaning in each blank. Do not look back for the answers.

55. deci = ________________________

56. kilo = ________________________

57. milli = _______________________

58. hecto = _______________________

59. centi = _______________________

60. deka = ________________________

The answers to these items are on the following page.

Answers to items 49 through 60.

49. deci = d

50. kilo = k

51. milli = m

52. deka = da

53. centi = c

54. hecto = h

55. deci = one tenth of

56. kilo = one thousand times

57. milli = one thousandth of

58. hecto = one hundred times

59. centi = one hundredth of

60. deka = ten times

If any of your answers are incorrect, erase the incorrect answers, reread the material, and answer the items correctly.

Answer the following items by writing the correct prefix and meaning in the blanks. Do not look back for the answers.

	Symbol	Prefix	Meaning
61.	da	_______	_______________________
62.	c	_______	_______________________
63.	d	_______	_______________________
64.	k	_______	_______________________
65.	h	_______	_______________________
66.	m	_______	_______________________

Answer the following items by writing the correct prefix and symbol in the blanks. Do not look back for the answers.

	Meaning	Prefix	Symbol
67.	0.1	_______	_______
68.	1 000 times	_______	_______
69.	0.01	_______	_______
70.	100 times	_______	_______
71.	10 times	_______	_______
72.	0.001	_______	_______

The answers to these questions are on the following page.

Answers to items 61 through 72.

	Symbol	Prefix	Meaning
61.	da	deka	ten times
62.	c	centi	one hundredth of
63.	d	deci	one tenth of
64.	k	kilo	one thousand times
65.	h	hecto	one hundred times
66.	m	milli	one thousandth of

	Meaning	Prefix	Symbol
67.	0.1	deci	d
68.	1 000 times	kilo	k
69.	0.01	centi	c
70.	100 times	hecto	h
71.	10 times	deka	da
72.	0.001	milli	m

If any of your answers are incorrect, erase the incorrect answers, reread the material, and answer the items correctly.

Ten facts that summarize what has been presented in this unit:

1. The meter (m) is the basic unit of length in the metric ysstem.
2. The liter (l) is the basic unit of volume in the metric system.
3. The gram (g) is the basic unit of weight or mass in the metric system.
4. Deci (d) means tenth (then decimeter means one tenth of a meter if measuring length).
5. Centi (c) means hundredths (a centiliter means a hundredth of a liter if measuring volume).
6. Milli (m) means thousandths (a milligram means a thousandath of a gram if measuring mass or weight).
7. Deka (d) means ten times (one dekaliter means 10 liters if measuring volume).
8. Hecto (h) means hundredths (one hectometer equals 100 meters if measuring length).
9. Kilo (k) means thousands (one kilogram equals 1 000 grams if measuring mass or weight).
10. The metric system involves multiplication and division by 10 and the powers of 10.

APPENDIX F

CHARACTERISTICS OF PARTICIPANTS

TABLE XXX

YEARS MEMBERSHIP IN THE AMERICAN DIETETICS ASSOCIATION OF DIETITIANS PARTICIPATING IN THE METRIC STUDY

Years of Membership	Absolute Frequency	Relative Frequency (Percent)
0-2 years	16	23.5
3-5 years	12	17.6
6-8 years	7	10.3
9-11 years	3	4.4
12-14 years	3	4.4
Over 14 years	27	39.7
Total	68	100.0

TABLE XXXI

NUMBER OF PROFESSIONAL MEETINGS ATTENDED BY PARTICIPATING DIETITIANS

Number of Meetings Attended	Absolute Frequency	Relative Frequency (Percent)
0	5	7.4
1	15	22.1
2	21	30.9
3	17	25.0
4	10	14.7
Total	68	100.0

TABLE XXXII

PROFESSIONAL POSITION OF PARTICIPATING DIETITIANS

Position	Absolute Frequency	Relative Frequency (Percent)
Clinical Dietitian	29	42.6
Administrative Dietitian	8	11.8
Consultant Dietitian	13	19.1
Teaching Dietitian	9	13.2
Research Dietitian	1	1.5
Other (Public Health, School Lunch)	8	11.8
Total	68	100.0

TABLE XXXIII

ROUTES FOR ACHIEVING ADA MEMBERSHIP BY PARTICIPATING DIETITIANS

Route	Absolute Frequency	Relative Frequency (Percent)
Dietetic Internship	56	82.4
Traineeship	2	2.9
Preplanned Work Experience	1	1.5
Degree Plus Work Experience	6	8.8
Coordinated Undergraduate Program	3	4.4
Total	68	100.0

TABLE XXXIV

HIGHEST DEGREE HELD BY PARTICIPATING DIETITIANS

Degree	Absolute Frequency	Relative Frequency (Percent)
Bachelor's Degree	43	63.2
Master's Degree	22	32.4
Doctoral Degree	3	4.4
Total	68	100.0

TABLE XXXV

UNDERGRADUATE GRADE-POINT-AVERAGE OF PARTICIPATING DIETITIANS

Grade-Point-Average	Absolute Frequency	Relative Frequency (Percent)
1.5 to 2.5	2	2.9
2.6 to 3.5	45	66.2
3.6 to 4.0	21	30.9
Total	68	100.0

TABLE XXXVI

PARTICIPATING DIETITIANS ATTITUDE TOWARD METRIC CONVERSION

Attitude	Absolute Frequency	Relative Frequency (Percent)
Support Metric Conversion	49	72.1
Oppose Metric Conversion	3	4.4
Undecided About Metric Conversion	16	23.5
Total	68	100.0

TABLE XXXVII

PARTICIPATING DIETITIANS KNOWLEDGE OF METRIC SYSTEM
PRIOR TO METRIC STUDY

Workable Knowledge	Absolute Frequency	Relative Frequency (Percent)
Yes	27	39.7
No	41	60.3
Total	68	100.0

TABLE XXXVIII

METHOD OF INSTRUCTION USED BY PARTICIPATING DIETITIANS FOR LEARNING THE METRIC SYSTEM

Method of Instruction	Absolute Frequency	Relative Frequency (Percent)
Workshop	2	7.4
Programmed Instruction	2	7.4
University or Extension Class	6	22.2
Self-Taught	17	63.0
Total	27	100.0

TABLE XXXIX

METHOD OF INSTRUCTION PREFERRED BY PARTICIPATING DIETITIANS FOR LEARNING THE METRIC SYSTEM

Method of Instruction	Absolute Frequency	Relative Frequency (Percent)
Workshop	26	38.2
Programmed Instruction	23	33.8
University or Extension Class	12	17.6
Telelecture	5	7.4
Total	68	100.0

TABLE XL

METRIC MEASURING EQUIPMENT AVAILABLE
FOR PARTICIPATING DIETITIANS

Equipment Available	Absolute Frequency	Relative Frequency (Percent)
Yes	39	57.4
No	29	42.6
Total	68	100.0

TABLE XLI

NUMBER OF AVAILABLE METRIC MEASURES
FOR PARTICIPATING DIETITIANS

Number	Absolute Frequency	Relative Frequency (Percent)
One	15	38.4
Two	14	35.9
Three	7	15.4
Four	4	10.3
Total	39	100.0

TABLE XLII

USE OF AVAILABLE METRIC MEASURES
BY PARTICIPATING DIETITIANS

Frequency of Use	Absolute Frequency	Relative Frequency (Percent)
Often	3	4.4
Sometimes	29	42.6
Never	36	52.9
Total	68	100.0

APPENDIX G

DATA FOR PEARSON PRODUCT-MOMENT CORRELATION

TABLE XLIII

DATA FOR PEARSON PRODUCT-MOMENT CORRELATION

Number	Years Membership	No. of Meetings	GPA	Attitude	Knowledge of Metric	Available Metric Equipment	No. of Metric Measures	Scores Pre-test	Scores Post-Test
1	3-5	1	2.6-3.5	Support	No	Yes	4	46	51
2	0-1	1	2.6-3.5	Undecided	Yes	No	0	37	47
3	12-14	1	3.6-4.0	Support	Yes	No	0	42	29
4	9-11	0	2.6-3.5	Support	Yes	No	0	42	49
5	Over 14	1	3.6-4.0	Support	No	Yes	2	37	37
6	9-11	1	2.6-3.5	Support	Yes	Yes	4	42	41
7	Over 14	3	2.6-3.5	Undecided	No	No	0	41	40
8	Over 14	4	3.6-4.0	Support	No	No	0	42	53
9	Over 14	2	2.6-3.5	Oppose	No	Yes	1	41	42
10	0-2	0	2.6-3.5	Support	Yes	Yes	1	45	46
11	12-14	2	3.6-4.0	Undecided	No	No	0	47	43
12	Over 14	1	2.6-3.5	Support	No	No	0	9	15
13	0-2	2	2.6-3.5	Support	Yes	Yes	3	48	46
14	3-5	3	2.6-3.5	Support	No	Yes	1	44	51
15	Over 14	2	2.6-3.5	Undecided	No	No	0	47	46
16	0-2	2	2.6-3.5	Support	Yes	Yes	1	50	53
17	3-5	3	2.6-3.5	Undecided	Yes	Yes	3	37	33
18	6-8	4	3.6-4.0	Support	Yes	Yes	2	49	54
19	3-5	1	1.5-2.5	Support	Yes	Yes	1	40	40
20	Over 14	2	3.6-4.0	Support	Yes	Yes	4	55	52
21	Over 14	2	2.6-3.5	Support	No	Yes	3	38	44
22	3-5	2	3.6-4.0	Support	Yes	No	0	56	56
23	6-8	4	3.6-4.0	Support	No	Yes	1	55	49
24	9-11	1	2.6-3.5	Support	No	Yes	2	41	45
25	Over 14	3	2.6-3.5	Undecided	No	Yes	1	48	44

TABLE XLIII (Continued)

Number	Years Membership	No. of Meetings	GPA	Attitude	Knowledge of Metric	Available Metric Equipment	No. of Metric Measures	Scores Pre-test	Scores Post-Test
26	0-2	4	2.6-3.5	Support	No	Yes	1	41	58
27	Over 14	4	3.6-4.0	Support	No	No	0	39	53
28	Over 14	2	2.6-3.5	Support	Yes	Yes	4	46	57
29	6-8	2	3.6-4.0	Support	Yes	Yes	2	51	57
30	Over 14	2	2.6-3.5	Undecided	No	No	0	13	42
31	3-5	2	2.6-3.5	Undecided	No	No	0	34	50
32	3-5	1	3.6-4.0	Support	Yes	Yes	3	49	52
33	Over 14	3	3.6-4.0	Undecided	No	Yes	1	37	58
34	12-14	3	3.6-4.0	Support	No	Yes	2	47	59
35	3-5	3	2.6-3.5	Support	No	Yes	1	42	57
36	6-8	3	2.6-3.5	Support	No	Yes	2	53	57
37	6-8	3	3.6-4.0	Support	Yes	No	0	48	56
38	3-5	2	2.6-3.5	Support	No	Yes	2	42	57
39	0-2	2	2.6-3.5	Support	Yes	No	0	44	58
40	0-2	1	3.6-4.0	Support	No	Yes	2	37	48
41	Over 14	3	2.6-3.5	Undecided	Yes	Yes	2	54	58
42	Over 14	1	2.6-3.5	Undecided	No	No	0	35	58
43	Over 14	3	3.6-4.0	Support	Yes	Yes	3	49	57
44	0-2	3	3.6-4.0	Undecided	No	Yes	2	35	54
45	Over 14	3	3.6-4.0	Support	No	Yes	3	45	58
46	3-5	4	2.6-3.5	Support	No	Yes	2	41	51
47	Over 14	0	2.6-3.5	Support	No	No	0	53	57
48	Over 14	4	3.6-4.0	Support	No	No	0	44	55
49	Over 14	3	2.6-3.5	Undecided	No	No	0	20	52
50	3-5	1	2.6-3.5	Support	Yes	No	0	51	57
51	0-2	2	2.6-3.5	Support	Yes	No	0	43	50
52	3-5	3	2.6-3.5	Support	Yes	Yes	2	42	58

TABLE XLIII (Continued)

Number	Years Membership	No. of Meetings	GPA	Attitude	Knowledge of Metric	Available Metric Equipment	No. of Metric Measures	Scores Pre-test	Post-Test
53	0-2	2	2.6-3.5	Opposed	Yes	No	0	30	51
54	0-2	2	1.5-2.5	Support	No	No	0	22	55
55	6-8	1	2.6-3.5	Support	No	No	0	37	59
56	Over 14	2	2.6-3.5	Undecided	No	No	0	38	49
57	Over 14	3	2.6-3.5	Support	No	Yes	1	43	48
58	Over 14	0	2.6-3.5	Support	No	No	0	33	56
59	0-2	1	3.6-4.0	Support	Yes	No	0	28	58
60	0-2	4	2.6-3.5	Support	No	Yes	2	42	49
61	6-8	4	2.6-3.5	Support	No	Yes	2	47	49
62	0-2	2	3.6-4.0	Support	Yes	No	0	46	51
63	Over 14	0	2.6-3.5	Support	No	Yes	1	26	53
64	0-2	4	2.6-3.5	Undecided	No	Yes	1	41	56
65	Over 14	3	2.6-3.5	Opposed	Yes	No	0	28	57
66	0-2	2	3.6-4.0	Support	Yes	No	0	43	57
67	Over 14	3	2.6-3.5	Undecided	Yes	Yes	3	42	54
68	Over 14	2	2.6-3.5	Support	No	Yes	1	35	54

Vita 2

Shirley Osborne Gibbs

Candidate for the Degree of

Doctor of Education

Thesis: INSTRUCTING DIETITIANS IN THE METRIC SYSTEM OF MEASUREMENT

Major Field: Home Economics Education

Biographical:

Personal Data: Born in Bevinsville, Kentucky, April 25, 1937, the daughter of Mr. and Mrs. Troy Osborne.

Education: Attended elementary school in Bevinsville, Kentucky; graduated from Wheelwright High School, Wheelwright, Kentucky, 1953; received the Bachelor of Science degree from Berea College in 1957; attended Oklahoma State University and Oregon State University and received the Master of Science degree from Oklahoma State University in 1972; completed requirements for a Doctor of Education degree at Oklahoma State University in May, 1978.

Professional Experience: Therapeutic Dietitian in Columbus, Ohio, 1958-1960; Dietitian in McDowell, Kentucky, 1960-1963; Residence Hall Food Service Manager in Stillwater, Oklahoma, 1963-1966; Catering Supervisor in Corvallis, Oregon, 1967-1969; Director of Food Service in Emporia, Kansas, 1969-1971; Assistant Professor in Department of Home Economics, Western Kentucky University, Bowling Green, Kentucky, 1972-1978.

Professional Organizations: Kentucky and American Home Economics Association; Kentucky and American Dietetics Association; Kentucky Nutrition Council; Kentucky Restaurant Association; Omicron Nu; Phi Upsilon Omicron; Society for Nutrition Education; Food Service Management Organization; Kappa Delta Pi; and Kappa Kappa Iota.