THE RELATIONSHIP BETWEEN TEACHING AND
ATTAINMENT OF KNOWLEDGE AND SKILL
PERFORMANCE BY NURSE AIDES
IN A RURAL AREA

DISSERTATION

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Patricia Gauntlett, B.S.N., M.Ed.
Denton, Texas
May, 1978
Gauntlett, Patricia, The Relationship Between Teaching and Attainment of Knowledge and Skill Performance by Nurse Aides in a Rural Area. Doctor of Philosophy (Adult Continuing Education), May, 1978, 84 pp., 6 tables, bibliography, 27 titles.

The problem of the study was to determine the relationship between teaching methods and attainment of knowledge and skill performance of nurse aides in rural area nursing homes.

The purpose of this study was to determine the improvement in skills performance and knowledge gain in the population cited above. The skill to be learned was operation of an electronic thermometer. Skill performance was determined by comparing readings from the electronic thermometer with a reading from a glass thermometer, and by observance of the students' performance of essential steps in operation of an electronic thermometer. Determination of knowledge was through measurement on paper-and-pencil tests. Groups were taught using programmed instruction and teacher-taught methods. The sample population consisted of nurse aides in nursing homes in rural areas. The assumption was made that by means of statistical comparison, programmed instruction group performance results on both written and performance tests would not differ from the teacher-taught groups.
The procedure used for the study was to randomly assign rural nursing homes to each of the two treatment groups and the control group for the pilot study and the main study. A pretest - posttest design was used with testing of demonstration of the actual skill and of the written test performance evaluation, done prior to the instruction, immediately following the instruction, at three weeks following the instruction, and at six weeks following the instruction.

The analysis of variance on demographic data indicated no significant difference among the groups. An analysis of variance was used for statistical analysis of written test evaluation of knowledge and performance of the skill tests. On the demonstrated performance of the skill tests, results obtained showed that all three groups were significant at the .01 level on all three posttests. Since significant results were obtained, paired comparison $t$ tests were used to determine superiority of performance groups. Using the paired comparison $t$ test between groups, results obtained showed that the performance of the teacher-taught group declined with time; the programmed instruction group was superior to the teacher-taught group and control group at either the .01 or .05 levels after immediate posttest measurement, and after measurement at three weeks posttest. The sixth week posttest comparison of programmed instruction versus teacher-taught group was not significant. The teacher-taught group versus the control group paired
comparison t test of the performance demonstration test results showed a significant difference at the .05 level on the first posttest, but the paired comparison of the t test results of the two groups was not significant on either the three week or six week posttest.

The analysis of variance used on the pretest for written performance showed a significant difference at the .01 level; however, the analysis of covariance done on the posttest results showed no significant difference, indicating that the initial difference was of no consequence to the results obtained on the posttests. The paired comparison t test of the group means obtained from written tests showed that the programmed instruction group was superior to either the control or teacher-taught groups at the .001 level.

Overall the programmed instruction tool was more effective in teaching skill and learning of cognitive knowledge.

This report concluded that the evidence seems to support the use of programmed instruction as a means of economically and effectively teaching nurse aides who work in a rural area nursing home.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter</td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td></td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td></td>
</tr>
<tr>
<td>Hypotheses</td>
<td></td>
</tr>
<tr>
<td>Significance of the Study</td>
<td></td>
</tr>
<tr>
<td>Definition of Terms</td>
<td></td>
</tr>
<tr>
<td>Limitations</td>
<td></td>
</tr>
<tr>
<td>Procedures for Collection of Data</td>
<td></td>
</tr>
<tr>
<td>Instruments</td>
<td></td>
</tr>
<tr>
<td>Selection of the Population</td>
<td></td>
</tr>
<tr>
<td>Procedure for Analysis of Data</td>
<td></td>
</tr>
<tr>
<td>Results of Pilot Study</td>
<td></td>
</tr>
<tr>
<td>II. REVIEW OF RELATED LITERATURE</td>
<td>14</td>
</tr>
<tr>
<td>Review of Related Nursing Literature</td>
<td></td>
</tr>
<tr>
<td>III. METHODOLOGY</td>
<td>27</td>
</tr>
<tr>
<td>Research Design</td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td></td>
</tr>
<tr>
<td>Instruments</td>
<td></td>
</tr>
<tr>
<td>Implementation</td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td></td>
</tr>
<tr>
<td>IV. RESULTS AND DISCUSSION OF RESULTS</td>
<td>32</td>
</tr>
<tr>
<td>Testing the Hypothesis</td>
<td></td>
</tr>
<tr>
<td>V. SUMMARY, MAJOR FINDINGS, CONCLUSIONS AND IMPLICATIONS</td>
<td>40</td>
</tr>
<tr>
<td>Summary</td>
<td></td>
</tr>
<tr>
<td>Major Findings</td>
<td></td>
</tr>
<tr>
<td>Conclusions</td>
<td></td>
</tr>
<tr>
<td>Implications for Future Research</td>
<td></td>
</tr>
<tr>
<td>APPENDIX A.</td>
<td>46</td>
</tr>
<tr>
<td>APPENDIX B.</td>
<td>68</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>75</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table                                 Page
I. Demographic Variables ............... 34
II. Analysis of Variance for Demonstration of Performance Means of the Treatment Groups Immediately, 3 Weeks, 6 Weeks After Instruction. .......... 35
III. Posttest Demonstration of Skill Performance Using Paired Comparison ........... 36
IV. Pretest and Posttest Comparison of Means on Written Tests............. 37
V. Analysis of Covariance on Written Test Scores Using the First Score as Covariate. ........... 38
VI. Paired Comparison of Group Means of Posttesting Scores Obtained on the Written Test Performance. .......... 39
CHAPTER I

INTRODUCTION

Continuing education encompasses all those learning activities that occur after an individual has completed basic educational training. As change occurs in modern society, individuals must cope with change in the form of complex technological advances as well as serious economic issues and problems. As Helmer said,

It is becoming mandatory for us to strive to anticipate changes in our environment rather than attempt to deal with them belatedly and inadequately after it has become obvious that they are upon us (5, p. 2).

Technology has outrun social organization in every field of human endeavor, including medicine (1). As scientific knowledge has advanced in fields such as human biology, physiology, and electronics, the need for personnel with new skills to cope with these advances has emerged. New drugs and scientific equipment have led to a host of medical innovations and techniques which have revolutionized medical practices (8). Nursing, as an integral part of the medical profession, has arrived at a pivotal point in its existence. Its survival as a vital component of the health professions depends upon whether the majority of nurses expand their knowledge and skill in order to practice therapeutic patient
For some nurses, the therapeutic use of one's self may be simply a nursing technique. To the degree that she is skillful, the technique achieves its purpose and the patient profits by it (2, p. 500).

In our present system of delivering nursing care, Frances Reiter describes a pyramid of personnel. The broad base of this pyramid is represented by the ever-growing numbers of ancillary personnel, the narrow apex by the relatively smaller number of professional nurse practitioners. She feels that it is the ancillary personnel who provide the bulk of direct care to the patient. The contact of professional nurses (those nurses who are educated above the minimum amount of education of one year or more) is limited to patient contact when performing complex technical procedures, administration responsibilities, or supervision of the ancillary worker (7). Therefore, the nursing educator must concentrate on effective education in nursing at the very basic level--those personnel with the least amount of training, who will be performing basic techniques or skills in direct patient care. Inservice education may be defined as including all those educational activities provided to employees by the employing agency and designed to improve on-the-job services. Inservice education originated as a response to a need: the obvious necessity to train the unskilled persons who become nurse aides. Inservice education is expensive and is obviously supported by patients directly or indirectly, through their insurance. Educational
offerings cannot be justified by institutions unless they result in improved patient care or service. Small hospitals and nursing homes often provide only limited amounts of inservice education for their employees. The cost of traditional methods of teaching is prohibitive for institutions outside metropolitan areas, even if qualified personnel were available (3). However, the Joint Commission on Accreditation of Hospitals states, "There shall be continuing training programs and educational opportunities for the development of personnel" (6, p. 52).

The United States Department of Public Welfare also issues guidelines for the establishment of inservice programs for nursing homes. Programs are required for all types of personnel who are members of nursing staffs. One can hardly argue with the assertion that formal planning for educational needs is a necessity in a well regulated nursing department, in order to meet patient's institutional, and individual staff needs.

This study focuses on the extent to which educational methods chosen are appropriate for acquisition of basic skills, performed by the largest group of adult nurses, who are largely poorly trained and educated, in rural areas where usual methods of acquiring skills cannot be utilized due to lack of qualified personnel, funds, and other resources.
Statement of the Problem

The problem of the study was to determine the relationship between teaching strategies and attainment of knowledge and skill performance of nurse aides in rural-area nursing homes.

Purpose of the Study

The purpose of this study was to determine the improvement in skills performance and knowledge gain in the population cited in the problem statement. The skill to be learned was operation of an electronic thermometer. Determination of accuracy was through use of an oral thermometer for temperature accuracy and observance of performance of essential steps in operation of electronic thermometer. Determination of knowledge was through measurement on paper-and-pencil tests.

Registered nurse teachers are scarce in rural areas. If programmed materials could be utilized to teach new techniques or use of new equipment, less time and supervision would be required of the registered nurse.

Hypotheses

There is no significant difference in attainment of basic skill of accuracy, as measured by a glass thermometer, immediately following teaching among all three groups of those nurse aides.
There is no significant difference of attainment of basic skill of accuracy as measured by a glass thermometer after three weeks following teaching among all three groups of nurse aides.

There is no significant difference of attainment of basic skill of accuracy as measured by a glass thermometer after six weeks following teaching among all three groups of nurse aides.

There is no significant difference of knowledge attainment immediately following teaching among all three groups of nurse aides as measured through statistical analysis of a paper-and-pencil objective test.

There is no significant difference of knowledge attainment three weeks following teaching among all three groups of nurse aides as measured through statistical analysis of a paper-and-pencil objective test.

There is no significant difference of knowledge attainment six weeks following teaching among all three groups of nurse aides as measured through a statistical analysis of a paper-and-pencil objective test.

Significance of the Study

The study is significant in that it

(1) Develops implications for continuing education planning in rural areas, if in fact, significant difference exists in attainment of skill and knowledge by nurse aides
through use of traditional-skill teaching methodology and individualized learning instruction modules occurs.

(2) Develops implications for educators of nursing personnel for skill training if, in fact, significant difference exists between basic skill and knowledge attainment by nurse aides through use of teacher-taught methodology and individualized learning instructional modules occurs.

Definition of Terms

The following terms have restricted meaning and are thus defined for this study:

Nurse aide is defined as a non-professional nursing person trained on the job, who assists the professional nursing staff in providing basic technical nursing skills for the patient.

Control group is defined as the group who were given Electromedics Company materials as learning tools.

Traditional teacher-taught method is defined as teaching methods in which continuity, reinforcement, imitation, and practice are utilized by the teacher in description and demonstration of the skill to be learned.

Individualized programmed learning is defined as a teaching method which involves active participation by the learner, learning by reinforcement of correct response, and mastery of previous steps in a logically related sequence of instruction.
Glass thermometer is defined as either an oral or rectal thermometer used in determining the temperature of a human being. The thermometer uses mercury and is accurate within 2/10 of a degree at 98 degrees Farenheit and 102 degrees Farenheit, as specified by the United States Department of Commerce "Product Standard for Clinical Thermometers."

Electronic thermometer is defined as either an oral or rectal thermometer used in determining the temperature of a human being, which employs a temperature-sensitive resistor which has been precalibrated at the factory to accuracy of +.2 degrees Farenheit, +.1 degree Centigrade, within the range of 90.0 degrees Farenheit to 105.0 degrees Farenheit.

Rural area is defined as an area not within 100 miles of a major metropolitan area of 100,000 or more, or an area not within 100 miles of a major medical center.

Limitations

In clinical studies done by Health Devices (4), it proved significantly harder to train nurse aides and practical nurses than registered nurses in the use of electronic thermometers, owing to resistance to change to a new technique from a previously learned technique.

Period of time may also influence retention of knowledge or skill, but excessively high personnel turnover (greater than 65 percent) limits the ability of this study to measure learning over a longer period of time.
The design of the study in itself with the use of the same written pretest and posttest, allowed for improvement upon taking the test a second time and would affect internal validity.

Procedures for Collection of Data

A pilot study was done on three rural nursing homes to determine if instruments and teaching methods do indeed teach essential content. Item analysis of paper-and-pencil test results for difficulty and discrimination was done to determine test content. An independent observer, who had no knowledge of which procedure was used, was utilized to determine skill performance on a pass-fail basis. An analysis of variance was used on all three groups to compare data obtained by written testing. A chi-square was used to compare observed results obtained from all three groups. Testing was done prior to teaching of all groups, immediately after teaching, three weeks after teaching, and six weeks after teaching. Test groups were randomly selected in order to control for history effects. A nine-way variance estimate was done to test the effect of age, sex, race, educational background, English as primary language, and years of experience upon the effectiveness of learning.

Permission was obtained from the Regional Director of the nursing homes of a national nursing home corporation to utilize the entire group of nursing homes in their southwest
region which encompasses areas in Oklahoma, Texas, and Louisiana. Stipulation was made by the Director that no names of nursing homes or personnel be used in the study. Electronic thermometers were obtained and verified for accuracy from Electromedics, Denver, Colorado, for use in all homes. Operating instructions which were developed by the Company were utilized only in homes selected for study by the control groups. Those homes not utilized for the pilot study were used in the dissertation study.

In the nursing homes, all aides utilized met the criteria defined previously in the Definition of Terms. Any aide who had previous contact with the use of any electronic thermometer was excluded from the study.

All teaching was done by a registered nurse who had been trained in the procedure, and included verbal as well as written material, to rule out variables of visual or auditory effects on learning.

Testing for performance was done by an unbiased registered nurse trained by the researcher in the procedure, but unaware of the methodology used for teaching. Testing was done after teaching, three weeks after teaching, and six weeks after teaching.

Students were using the thermometers in the clinical area, so that the effect of practice was equal, or as nearly equal as possible, for all groups during this time.
Instruments

The instrument used to measure accuracy of performance for the use of the electronic thermometer was a glass-and-mercury thermometer certified by the states of Connecticut, Michigan, and Massachusetts as accurate enough to meet United States Department of Commerce requirements.

Testing instruments are shown in Appendix A; examples of teaching plans, programmed instruction, and company materials are also shown in the appendix.

Selection of the Population

Three nursing homes selected at random were utilized for the pilot study and nine nursing homes were selected at random for the remainder of the study population. Randomization of aides for different methodologies was not possible in the homes, owing to the small sample population of aides employed in some homes; however, each group had a minimum of twenty subjects.

Procedure for Analysis of Data

Since testing involves ratio data, the analysis of variance is a method for dividing the variance observed in experimental data into different parts, each part assignable to a known source, cause, or factor. The researcher can then ascertain whether a particular part of the variation is greater than expectation under the null hypothesis. Essentially, what the researcher is doing is assigning treatments
which are teaching methodologies) to each of K samples (which are nursing homes), with each sample being comprised of n members (which is the number of members in each group). A comparison of the means of these groups provides information on the efficiency of the different measures and the analysis of variance may be used to decide whether the variation between means is greater than that expected from random sample fluctuation.

A chi-square was used to compare pass-fail of the performance by the student on the use of the electronic thermometer. Since it was frequency on nominal data which the researcher was measuring, non-parametric methods were appropriate. Chi-square was particularly appropriate, since the researcher compared observed with theoretical frequencies. The observed frequencies were those obtained directly by observation. When the difference between observed and theoretical frequencies was significant, the null was rejected.

Results of Pilot Study

A pilot study was done to determine if the study was feasible, tools were reliable, and generalizations could be made from the pilot study to improve the procedure prior to the main study.

The pilot study was done at three nursing homes within the region, selected at random. Groups consisted of twenty
members, each taught using company materials, programmed material, and teacher-taught methods; each taught according to the procedures previously outlined. The results are summarized in Tables II through IX.

Essentially, all groups learned over the four testing times. Teacher-taught groups and programmed groups in testing for knowledge were far superior to the control group. There was no significant difference between programmed learning groups and teacher-taught methods groups.

Age, sex, education levels, years of experience, English as primary language, and ethnic groups were not significant in acquiring knowledge for any group or for acquiring skill in any group.

Skill testing for each group showed significant learning improvement as measured by pass-fail for each group: the results are summarized in Tables X through XII. All groups were able to learn the skill, and retain the ability to perform the skill during the six-week period of time after initial teaching. The control group retained the skill better than the teacher-taught group as evidenced by a higher passing score on testing; although not at a significant level. Programmed learning groups retained the skill best with all students able to perform the skill as measured by testing, six weeks after initial teaching.
BIBLIOGRAPHY


3. Cooper, Signe S., "This I Believe About Continuing Education in Nursing," Nursing Outlook, XX (September, 1972), 579-583.


CHAPTER II

REVIEW OF RELATED LITERATURE

A review of the literature suggests that there is a need and demand for research into the area of innovative and effective skill education programs. Recent developments in instructional technology further suggest an increased need to develop and evaluate instructional modules which can be utilized in skill training programs. With the rapid scientific advances in the field of technology and the use of these new technologic advances in the practice of nursing, educational institutions, as well as their sister components in inservice education, need to focus on ways to prepare nurse practitioners to learn new skills. Consequently, the attempt of this study was to compare a programmed instructional method and a traditional education method with respect to the effect of each method on cognitive knowledge and skill performance of nurse aides employed in nursing homes in a rural area. Accordingly, this study requires a basic understanding of the types of methodology employed, and effect of method on learning performance. It also requires an understanding of methodology which has been traditionally employed by the teacher to facilitate the learning of skills by the student. This chapter focuses on areas within the literature germane to this study.
The field of skill teaching lacked any great pioneer or theoretical dogma, and unfortunately, lacked research until the twentieth century. The changes brought about by our rapidly expanding technology during the twentieth century have emphasized skill training research in industry, and skill training research to train people to learn new skills or update previously learned skills.

A skill has four characteristics: it represents a chain of motor responses, coordination of hand and eye movements, organization of chains into complex response patterns, and an understanding of the components of each chain unit. According to Gayne, each link is an individual stimulus-response unit which acts as a stimulus to another unit, until chaining or sequencing occurs. As the individual units in the chain are sequenced in close succession, contiguity is established. With repeated practice, forgetting does not occur, since residual incorrect connections become extinct. Finally, with reinforcement, the learner develops satisfaction and the motivation to continue using the chain (6).

Fitts identifies three continuous phases through which the student moves in learning a complex skill. During the cognitive phase the student attempts to intellectualize the skill, while the instructor gives knowledge about the process. During the fixation phase the student learns the correct behavior response with practice reinforcing the correct response, to eliminate error. During the autonomous phase,
the student learns to discriminate inappropriate stimuli and react accurately, almost reflexively, to the skill (7).

Skill research has also focused on the use of the part method versus the whole method. Part method is teaching the skill in small units with the individual not proceeding to the next unit until the prior unit is learned. Whole method is teaching the skill as an entire unit with no attempt made to teach the skill in small units. James Naylor (20), when summarizing the evidence on this research, feels as if, for skills which are not difficult or not highly organized, the use of the part method is best; however, the whole method is best for those skills of a difficult and highly organized nature.

In order to teach skills, according to Pohl, the teacher must eliminate trial and error, guiding the learner to learn the correct answer. Demonstrating for the learner what is to be done is the logical first step in skill teaching, but it must be followed by giving him an opportunity to become familiar with the equipment and to practice using it. In addition, the teacher must be sure that the learner is physically able to perform necessary techniques, and must allow sufficient repetition and practice for the learner to master the technique (23).

Evidence of the effects of feedback on skill performance are shown in the classic experiments of Elwell and Grindley and of Thorndike. In Grindley's experiment (5),
feedback has a direct effect on learning of a skill. In the Thorndike experiment (32) which used varying periods of delayed feedback, all groups showed improvement in learning of the skill. Irion (12) feels that feedback is the single most important variable affecting acquisition of skills.

De Cecco recommends the following steps to be taken in the teaching of skills to students. Analysis of the skill, arrangement for training in the component units of the skill, description and demonstration of the skill by the teacher, and provision of basic learning conditions are the essentials of his process (3).

Related to the specific skill of using electronic thermometers and glass thermometers, several articles pointed to the need for more effective teaching or research to determine accuracy of both electronic and mercury thermometers. In clinical studies, it proved significantly harder to train practical nurses and nurse aides than registered nurses to use electronic thermometers. The best of electronic thermometers deployed in an optimum fashion were more cost effective and accurate than mercury thermometers. Since most mercury thermometers in use today were not calibrated to government standards, the readings obtained from these thermometers could not be identified as accurate. In addition, the studies could not agree on the time length needed for accurate reporting of temperature by use of the mercury thermometers. Time length varied from three to ten minutes
of actual temperature measurement. Electronic thermometers were recommended for use with patients who were irrational or who were receiving supplementary oxygen were thought to help minimize possible physical injury. The electronic thermometer was recommended as the instrument of choice for use in the nursing home (2, 6, 8, 14, 18, 21, 29, 30).

In the area of methodology, Glaser believes that several forces are changing the nature of educational practice. The increased focus on the cultivation of skill, understanding, and intellectual power in the basic disciplines, and the advances in the psychological and technological foundations of education are contributing factors to the growing belief that individualized instruction is an ideal and practical enterprise (10).

Programmed instruction, as used in this study, has four major characteristics: (1) the material is task analyzed, terminal behaviors for the student is identified and broken down into units, (2) the student responds to each unit, (3) the student response is followed by feedback which identifies the correct response, (4) the units are sequenced to provide minimum error of response.

Some research studies concerned with the relative effectiveness of programmed and conventional modes of instruction show no statistically significant difference between the instructional methods under investigation. Schramm's survey of 36 studies dealing with the relative merits of
programmed and conventional approaches indicated that when achievement test scores were used as the criterion, 18 studies showed no significant difference between the two methods, 17 reported results significantly favoring the programmed approach, and one study reported a significant difference that favored the programmed approach (26). The findings by Saettler also indicated that there were no significant difference in effectiveness in learning between instructional methods (25).

In a study done by Dubin, no evidence of consistently superior teaching methods in traditional classroom instruction was found in an analysis of 74 studies of comparative teaching methods. Twenty-three of these studies analyzed student-teacher ratios and indicated that teaching skill was more influential in learning than reduced student-teacher ratio (4). However, in a study done by Myers on group project activities and participants' acquisition of vocational skills, it was concluded that no unique skills were required of the instructor (19).

Other related questions have also been studied. The following studies focus on related aspects with or within methodology in technical skill education. Holzmullar, in an evaluation of automated teaching methods compared to other methods, and their applicability to rural students, noted that automated teaching motivated low achievers, freed the teacher to help in areas most needed, was equally
effective with various ethnic groups, and was equally
effective with both sexes (11). Parker, using self-paced,
self-instructional modules to teach skills to technicians,
found that students became independent learners, however,
the time required to master a skill did vary. He also
found that modules freed the teacher from repetitive prepa-
trations of routine teaching materials (22).

Sargeant, in his study of high school industrial arts
students, college students, and adults who were enrolled in
a self-paced instructional system to learn arc welding,
found that this system was effective in teaching knowledge
and high-level perceptual motor skills, based upon results
of acceptable performance by all participants. The study
also suggested that general mental ability appeared to be
an irrelevant factor in learning arc welding skills (27).
This is contrary to Jamison's viewpoint that studies in
the use of programmed instruction indicate that students
who demonstrate higher levels of intelligence perform
better and learn better, as evidenced by posttest gain
scores. Jamison also noted that students who demonstrate
high achievement motivation and anxiety performed better
with programmed instruction than with traditional teaching
methods (13).

Research in the use of teacher-taught methods and
programmed methods indicates no difference in acquisition of
learning between the two methods. Germane to this study,
low achieving ability, low mental ability, and high anxiety of students, did not influence students' ability to learn when the student is taught using the programmed instruction method; while the teacher's skills may or may not be a factor in increasing the students' ability to learn when the students are taught using traditional teacher methods.

Research related to the design of programmed instruction revealed no studies comparing design structure and learning effectiveness. However, Travers noted that a decrement in learning results from switching sensory channels during the course of a presentation (34). Of note, in regard to learning in general, performance on tasks involving pictures was almost always superior to that on tasks involving words (16).

Review of Related Nursing Literature

An exhaustive review of nursing literature revealed few studies related to skill teaching or comparison of instructional methodologies. Bitzer reported that the University of Illinois used self-instructional materials to teach students. This method proved to be as effective in acquisition of knowledge and skills as traditional lecture and discussion methods (1). This was supported by faculty at the University of Rochester School of Nursing who reported that levels of achievement in acquisition of knowledge and skill among students in their program through
use of programmed instruction was comparable with traditional teaching methods. In addition, students who utilized programmed instruction, progressed faster through the program and demonstrated both increased motivation to learn (17). Studies done by Thompson on diploma nursing students, who learned through either traditional or audio-tutorial methods, showed no significant differences in either immediate learning, or retained learning which was measured one year later (31). This finding was also supported in a study done by Stein, Steel, Fuller, and Langhoff, which assigned traditional methods to the control group and self-instructional materials to the experimental group, in a baccalaureate program of instruction. No significant differences occurred in learning (28).

The only specific study found comparing the effects of self-instructional and traditional methods on skill performance of nursing students was done by Quiring (24). In this study, sophomore baccalaureate nursing students were assigned to groups who were taught to give injections through use of traditional lectures or through use of programmed instruction. No significant differences were found. Feedback, either immediate or delayed, did not appear to influence learning or performance.

In summary, no studies were found using adult non-professional nurses as subjects in skill learning or using an instructional strategy to achieve learning. The few
studies found in nursing indicate that self-instructional methods are as effective as teacher-taught methods.

The need for research in the field of adult education is directly related to the purpose of this study. As Malcolm Knowles stated,

Need is the prevention of obsolescence. This need arises from the fact that most adults alive today were educated in their youth..., that the purpose of education is to supply individuals in their youth with all the knowledge and skills they will require to live adequately for the rest of their lives. These facts are untrue and skills learned in youth may have become outmoded by new technologies (15, p. 23).

Since the nurse teaches people of all ages and levels of education, she must be able to teach co-workers as well as patients. Co-workers would include the such less well educated individuals as the nurse aide. According to Torrence, some characteristics which distinguish under-educated adults from better educated adults as learner are that they are difficult to involve, they live for today, they are skeptical of the system and those who appear to represent the system, they are doubtful of their ability to learn, and they are easily discouraged if evidence of progress is not regularly recognized (33). Since this study deals with adult learners of a lower educational level, it is appropriate to note these general characteristics which may affect learning.
BIBLIOGRAPHY


CHAPTER III

METHODOLOGY

Research Design

The purpose of this study was to determine if a significant difference in learning occurred between nurse aides who learned a skill using programmed individualized instruction and those nurse aides who learned a skill through traditional teacher-taught methodology. Individuals were pretested initially, then posttested immediately upon learning the skill, and at three weeks later, and at the end of six weeks. Posttesting included a written multiple-choice test to measure cognitive knowledge and a pass-fail test of skill performance. Data variables of age, sex, education, ethnic background, English as a primary language, and years of experience were collected by means of a questionnaire and analyzed for significance. Posttesting also included the pass-fail evaluation of the skill of accurately using the electronic thermometer. Pass-fail was determined by the same independent registered nurse observer for all groups at all testing periods.

Population

The population of this study consisted of nurse aides who were employed in nursing homes in rural sections of
Texas and Louisiana. Any nurse aide with prior knowledge of or experience with the skill was eliminated from the study. The six rural nursing homes were randomly assigned to two control groups, two programmed instruction groups, and two teacher-taught groups. No attempt was made to randomize subjects to groups, since the population employed in each home was so small. A total of 120 subjects were assigned to the groups.

Instruments

A questionnaire was developed to collect data from the subjects involved in the study. (Appendix A).

After the task analysis of the skill was completed, a programmed text was developed to teach the operation of an electronic thermometer (Appendix B). The degree of success of the program in teaching students was shown by effective performance of the skill and on the written test during the pilot study.

The teacher-taught group utilized a concept-based written instructional text and lecture-demonstration by the teacher. Evidence of the effectiveness of the teacher and of the text was shown by effective performance of the skill and on the written test by the participants in the pilot study.

A discrimination index and difficulty index were utilized to analyze data from test items in the pilot study.
Items on the test indicated a suitable level of difficulty as well as the ability to discriminate between the performance of low and high achievers. The pretest and the posttest were identical. Subjects were rated, by the same registered nurse, as passing or failing on their ability to accurately take a temperature with an electronic thermometer. Accuracy of the student's reading was determined by comparison of corresponding readings taken with a mercury glass thermometer by the registered nurse. The same registered nurse verified accuracy of the student's reading, by reading the mercury glass thermometer and comparing results with the electronic thermometer reading.

Implementation

Permission was obtained from the Regional Director of the Nursing Homes to utilize homes throughout the region in the study. Electronic thermometers were obtained from Electromedics, Incorporated after being certified for accuracy. The registered nurse was trained by the researcher to present the teacher-taught lecture demonstration. Programmed materials were developed. Instructional materials developed by Electromedics, were obtained from the electronic thermometer company. Mercury glass thermometers which had been certified for accuracy were obtained.

The pretest and questionnaire were given to all nursing aides in the nursing home. No nurse aide had prior knowledge of the skills.
The teaching was accomplished in the space of one week by the registered nurse in each of the homes which were designated to be used as teacher-taught groups. The researcher observed all performances. The instructions were given to each member of the group. After each member had completed reading the instructions, the nurse-teacher demonstrated the skill. Testing of the groups' knowledge and performance of the skill was done by the registered nurse and observed by the researcher. Students were allowed to keep materials which were used during teaching.

Teaching of the control-groups was accomplished the following week. The control groups received the written electronic thermometer company produced material. After each aide had finished reading instructions, the registered nurse, observed by the researcher, tested the group for knowledge and performance. Materials which were used for teaching were left with each student.

The programmed teaching was accomplished during the third week. The individualized-program instruction groups were given the programmed test by the registered nurse. After each aide was completely finished reading the text, the registered nurse tested the group for knowledge and performance. The researcher observed the procedure. The programmed text was left with each student.
Three weeks after the initial testing, each group was retested in the same sequence by the company nurse and observed by the researcher.

Six weeks after the initial testing, each group was again retested in the same sequence by the company nurse and observed by the researcher.

Each group was able to practice the skill during the intervals between testing, on patients in their nursing homes.

Summary

This chapter has presented a description of the research design, the population, instrument design and validation procedures, and implementation procedure.
CHAPTER IV

RESULTS AND DISCUSSION OF RESULTS

This chapter presents and discusses the results of testing the hypotheses, together with an analysis of both the results of testing of written and skill performance before and after teaching occurred.

Testing the Hypothesis

There is no significant difference in attainment of basic skill of accuracy, as measured by a glass thermometer, immediately following teaching among all three groups of those nurse aides.

There is no significant difference of attainment of basic skill of accuracy as measured by a glass thermometer after one month following teaching among all three groups of nurse aides.

There is no significant difference of attainment of basic skill of accuracy as measured by a glass thermometer in six weeks following teaching among all three groups of those nurse aides.

There is no significant difference of knowledge attainment immediately following teaching among all three groups of nurse aides as measured through statistical analysis of a paper-and-pencil objective test.
There is no significant difference of knowledge attainment three weeks following teaching among all three groups of nurse aides as measured through statistical analysis of a paper-and-pencil objective test.

There is no significant difference of knowledge attainment six weeks following teaching among all three groups of nurse aides as measured through a statistical analysis of a paper-and-pencil objective test.

The hypotheses were tested by statistically analyzing results of pretest and posttest written performance and demonstration of the skill performance of the two treatment groups. After initial teaching of all groups, the groups were tested by paper-and-pencil examination and by performance of the skill immediately after instruction and after further intervals of three weeks and six weeks.

Demographic Variables

A one-way analysis of variance was used to determine if any significant differences existed in the demographic variables among the two experimental groups and the control group. Age, sex, years of education completed, ethnic background, English as primary language, and number of years worked in a hospital or nursing home were the identified demographic variables. The results of the analysis (Table I) showed that no significant differences existed between the
groups. All aides were English speaking as primary language, thus this factor was not included in the testing. Using a significance level of either .01 or .05, the observed F values for each value were not significant.

**TABLE I**

DEMOGRAPHIC VARIABLES

<table>
<thead>
<tr>
<th>Variable</th>
<th>F Test</th>
<th>Program</th>
<th>Teacher</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.80</td>
<td>2.71</td>
<td>2.48</td>
<td>2.71</td>
</tr>
<tr>
<td>Sex</td>
<td>.03</td>
<td>1.66</td>
<td>1.64</td>
<td>1.64</td>
</tr>
<tr>
<td>Education</td>
<td>.185</td>
<td>1.97</td>
<td>2.53</td>
<td>2.05</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>1.05</td>
<td>1.56</td>
<td>1.58</td>
<td>1.43</td>
</tr>
<tr>
<td>Experience</td>
<td>1.43</td>
<td>3.35</td>
<td>2.97</td>
<td>2.97</td>
</tr>
</tbody>
</table>

*p .05 = 3.10.

**p .01 = 4.80.

*** with 2 and 114 degrees of freedom.

In addition one could look at the means of each of the three groups and determine that very little difference existed among the group means. From this data the groups were determined to be homogeneous.

**Demonstration Performance Test**

An analysis of variance was used to determine if any significant difference existed between the total test performance means of the students in the two experimental groups and the control group. No student passed the initial
pretest. Assigning the number 1 to "pass", 2 to "fail", means were computed for each group. The F was then computed, with a resulting difference significant at the .01 level.

TABLE II

ANALYSIS OF VARIANCE FOR DEMONSTRATION OF PERFORMANCE MEANS OF THE TREATMENT GROUPS IMMEDIATELY, 3 WEEKS 6 WEEKS AFTER INSTRUCTION

<table>
<thead>
<tr>
<th>Means</th>
<th>F Test</th>
<th>Program</th>
<th>Teacher</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediately</td>
<td>7.34</td>
<td>1.12</td>
<td>1.30</td>
<td>1.51</td>
</tr>
<tr>
<td>3 Weeks</td>
<td>11.01</td>
<td>1.23</td>
<td>1.53</td>
<td>1.71</td>
</tr>
<tr>
<td>6 Weeks</td>
<td>4.80</td>
<td>1.43</td>
<td>1.61</td>
<td>1.76</td>
</tr>
</tbody>
</table>

*p .05 = 3.10.

**p .01 = 4.80.

*** degrees of freedom 2,114

Posttest Paired Comparison Between Groups

Since there was a statistically significant difference on the posttest comparisons on all treatment, a t test was used on the test scores obtained between the groups to determine whether a comparison between experimental testing means and control group testing means was statistically significant. Table III illustrates the paired comparison of the teacher group test means with the control group test. The effect of the teacher-taught group was significant immediately following instruction and decreased during the three week and six week periods after testing. Pairing
the program group means with the control group means, the effect of programmed instruction was significant at the .001 level or .005 over all posttesting time periods. Pairing the programmed group test score means and the teacher group test score means, a statistically significant difference occurred at the $p = .05$ level immediately after testing, and a statistically significant mean at the .005 level occurred on the third-week after testing at the .05 level; but no significance between the paired group means was found to exist at the sixth week after testing.

**TABLE III**

**POSTTEST DEMONSTRATION OF SKILL PERFORMANCE USING PAIRED COMPARISON**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups in Teacher-vs Control</th>
<th>Groups in Program-vs Control</th>
<th>Groups in Program-vs Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>1.86</td>
<td>3.94</td>
<td>1.94</td>
</tr>
<tr>
<td>3 Weeks</td>
<td>1.65</td>
<td>4.87</td>
<td>2.91</td>
</tr>
<tr>
<td>6 Weeks</td>
<td>1.47</td>
<td>3.12</td>
<td>1.59</td>
</tr>
</tbody>
</table>

a $p .05 = 1.67$.

b $p .01 = 2.38$.

c $p .005 = 2.68$.

d $p .001 = 3.21$.

e degrees of freedom 76.
Pretest and Posttest Comparison of Means of Written Tests

An analysis of variance was used on the written test results obtained from the two treatment groups and the control group for each of the testing periods. A significant F at the .01 level was obtained on the data obtained from all testing sessions, including the pretest.

TABLE IV

PRETEST AND POSTTEST COMPARISON OF MEANS OF WRITTEN TESTS

<table>
<thead>
<tr>
<th>Variable</th>
<th>F Test</th>
<th>Program</th>
<th>Teacher</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>7.05</td>
<td>7.25</td>
<td>6.15</td>
<td>8.12</td>
</tr>
<tr>
<td>Immediate post-test</td>
<td>16.06</td>
<td>22.48</td>
<td>19.15</td>
<td>19.00</td>
</tr>
<tr>
<td>3 Weeks posttest</td>
<td>16.56</td>
<td>20.53</td>
<td>18.05</td>
<td>15.53</td>
</tr>
<tr>
<td>6 Weeks posttest</td>
<td>35.89</td>
<td>19.71</td>
<td>14.05</td>
<td>12.73</td>
</tr>
</tbody>
</table>

*p .05 = 3.10.

**p .01 = 4.80.

*** degrees of freedom = 2,114.

Determination of Group Differences

Since a significant difference was found on the pretest results of the written test group means (Table IV), an analysis of covariance was done to determine if this difference would affect posttest results. Using the first score (pretest) as the covariate, no significant difference
at the .01 level was obtained from analysis of the written test scores when the adjusted means of the two treatment and control groups were used.

**TABLE V**

**ANALYSIS OF COVARIANCE ON WRITTEN TEST SCORES USING THE FIRST SCORE AS COVARIATE**

<table>
<thead>
<tr>
<th>Variable</th>
<th>F Test</th>
<th>Program</th>
<th>Teacher</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate posttest</td>
<td>16.10</td>
<td>22.49</td>
<td>19.04</td>
<td>19.09</td>
</tr>
<tr>
<td>3 Weeks</td>
<td>16.29</td>
<td>20.53</td>
<td>18.09</td>
<td>15.49</td>
</tr>
<tr>
<td>6 Weeks</td>
<td>36.16</td>
<td>19.70</td>
<td>14.20</td>
<td>12.09</td>
</tr>
</tbody>
</table>

*p .01 = 4.80.*

** degrees of freedom 2,113.

**Paired Comparison of Written Test Scores**

Since a significant difference was determined for all written posttest, a t test was used to determine effects between test means of two paired groups. In the teacher-paired-with-control group means, the immediate posttest was not significant at the .05 level. The three week posttest was significant at the .01 level; the six week posttest was significant at the .05 level. In the program-paired-with-control group means, all posttests means were significant at the .001 level. In the program-paired-with-teacher groups, all post test means were significant at the .001 level.
TABLE VI

PAIRED COMPARISON OF GROUP MEANS OF POSTTESTING SCORES OBTAINED ON THE WRITTEN TEST PERFORMANCE

<table>
<thead>
<tr>
<th></th>
<th>Teacher-vs Control</th>
<th>Program-vs Control</th>
<th>Program-vs Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate posttest</td>
<td>.17</td>
<td>4.96</td>
<td>5.67</td>
</tr>
<tr>
<td>3 Week posttest</td>
<td>2.55</td>
<td>5.77</td>
<td>3.36</td>
</tr>
<tr>
<td>6 Week posttest</td>
<td>1.71</td>
<td>9.39</td>
<td>6.38</td>
</tr>
</tbody>
</table>

a $p .05 = 1.67$.

b $p .01 = 2.38$.

c $p .005 = 2.65$.

d $p .001 = 3.21$.

e degrees of freedom 76.

Based upon the analysis of the data as presented in this chapter, the programmed learning method was superior to the teacher-taught method in both written test performance and demonstration of the skill.
CHAPTER V

SUMMARY, MAJOR FINDINGS, CONCLUSIONS,
AND IMPLICATIONS

Summary

The purpose of this study was to determine whether knowledge of a technical skill and performance of that skill differed between groups who had been taught using a programmed text, and those groups who had been taught using a traditional teacher approach. To accomplish this purpose; (1) a self-instructional unit was developed, (2) a plan for the method of instruction of the teacher was developed which used a written handout, (3) a technical skill, the use of an electronic thermometer was identified, (4) company developed handouts were obtained from the electronic thermometer company, Electromedics, to serve as teaching material for the control group, and (5) a group of nursing homes in a wide range of rural areas was selected for testing purposes.

Training Materials and Procedure

A self-instructional unit was developed. This unit consisted of a written text with visual aides, presented in a step-by-step programmed information format. A registered nurse was employed and taught the teaching strategy. The
registered nurse gave a verbal presentation, written handouts, and demonstration of the procedure. The company materials for operation of the electronic thermometer consisted of basic operating instructions and a drawing of heat pockets in the mouth. A pilot study was done to validate instruments and procedure.

After permission was obtained for use of the nursing homes, six nursing homes were randomly selected for the pilot study. The remainder of the homes were randomly assigned to three groups for the main study. The procedure followed in the main study was essentially identical with that of the pilot study. All aides filled out a questionnaire. Any aide with previous knowledge of the use of the electronic thermometer was disqualified. All aides were pretested, then taught in three groups designated teacher, programmed text, or control. Posttesting occurred immediately after teaching, after three weeks, and after six weeks. Posttesting consisted of a written test and performance of the skill. All written posttesting was observed under similar conditions; all skill testing was observed by the same observer.

An analysis of variance was used on the demographic variables to determine if any significant difference existed between the groups. An analysis of variance was also done to test nurse aide performance on written tests and on demonstration of performance of skill tests. A paired
comparison using the \textit{t} test was then done to determine the effects of test means between two paired groups. An analysis of covariance was used on the written test groups since an initial significant difference between groups was found on the pretest. Since no significant difference was found through analysis of covariance for the written tests, a \textit{t} test was again employed to compare the effects of test means between two paired groups.

**Major Findings**

There were no significant differences between groups at the .01 level on the demographic variables, therefore the groups were considered homogeneous. On the demonstrated performance of the skill, all three groups were significant in attainment of skill at the .01 level for all three post-tests. The paired comparison on \textit{t} test between groups revealed that the performance of the teacher-taught group declined with time; the programmed instruction group performances were superior to the teacher and control groups performance at the .05 level, with the exception of the sixth-week posttest comparison of the programmed group performance versus teacher-taught group performance. The teacher-taught group performance versus the control group performance showed a significant effect (.05 level) on the first posttest, but the teacher-taught group performance was not significant on either the three week or six week
posttest. The analysis of variance done on the pretest for written performance showed a significant difference at the .01 level; however, the analysis of covariance which was done on the posttests showed no significant difference indicating the initial difference was of no consequence. The paired-comparison *t* test of the means of the written tests showed that the programmed-instruction unit was superior to both the control or teacher-taught groups at the .001 level.

Overall, the programmed instruction tool was more effective in teaching the skill and cognitive knowledge and therefore, all of the null hypotheses previously presented in this paper were rejected.

**Conclusions**

The following conclusions are based upon the evidence obtained from implementation and testing of this study.

1. The programmed instruction groups were superior to either the teacher-taught or control groups on written test performance and demonstration of the skill, at a high level of significance.

2. The programmed instruction group was able to retain knowledge and skill better than either the teacher-taught group or the control group over the length of the testing period with the exception of the
six week skill performance test comparison of the teacher-taught group and the programmed instruction-taught group.

3. The programmed unit as used in this study could be used for all sex and age groups of differing educational, experience levels, or ethnic backgrounds.

4. The teacher-taught group decreased in performance of the skill over the period of the testing time, but was significantly effective for retention of knowledge as measured by the written test over the period of the testing time.

Implications for Future Research

Based on the conclusions in the study, the following implications were identified for the future use of self-instructional programs in skill teaching.

1. Skill teaching can be accomplished using programmed texts with people of all sex and age groups, with a wide range of educational, and experiential backgrounds. Replication of this study in other areas of education is recommended to verify the results and conclusions.

2. Self-instructional programmed texts for other skills requiring higher level performance should be developed and tested.
3. Replication of this study using a larger group with more diverse ethnic backgrounds over a longer period of time is recommended to verify results and conclusions.
DATA VARIABLES

Fill in appropriate response:

1. By which method were you taught?
   a. teacher-taught group
   b. programmed text group

2. Age
   a. 18-25 years
   b. 26-40 years
   c. 41-60 years
   d. above 60 years

3. Sex
   a. male
   b. female

4. Education completed
   a. high school graduate or equivalent (GED)
   b. nurse aide training
   c. licensed professional (LVN, RN, etc.)
   d. 1-4 years of college
   e. not high school graduate

5. Ethnic background
   a. Caucasian
   b. Black
   c. Mexican-American

6. English as primary language
   a. yes
   b. no

7. Years worked in a hospital or nursing home
   a. 0-6 months
   b. 6 months - 1 year
   c. 1-2 years
   d. 2-5 years
   e. 6 years or above
TEACHER-TAUGHT METHOD OF LEARNING

Directions:

1. Do not give out hand-outs. Show procedure first. As you are demonstrating, explain the principle to the aides, then give the sheets to the aides. Allow time for the slowest to read why.


**Action**

1. Insert thermometer in probe cover all the way to the shoulder of the thermometer.

2. Remove paper sheath from probe cover by twisting on perforated line.

3. For all temperatures, press button on the thermometer and release.

4. The digital read-out on the display will read 81.90°F but will change as the room gets warmer or colder.

5. For oral temperatures, place probe slowly into patient's mouth, making sure to position tip of probe at left posterior sublingual pocket.

6. For rectal temperatures, insert the silver tip slowly about ½-inch past the sphincter muscle. Tip the unit slightly.

**Principle**

1. Partial covering of the probe will allow germs or organisms to contaminate the probe.

2. Failure to twist on the dotted line will damage the plastic underneath and might tear the covering.

3. Pressing the button will cause the latch light to light and give a digital read-out, so you know if the battery is charged.

4. The display read-out of 81.90°F tells you that the unit is standardized, as the room gets warmer or colder, the silver probe will measure the change.

5. So you can see different places in the mouth are warmer or cooler than others. The most accurate spot is labeled No. 1.

6. Rectal temperatures also vary as do oral temperatures. One-half inch penetration gives the most accurate reading. Tipping the unit slightly helps the unit contact the tissue to ensure a correct reading.
7. The red light above the numeral display lights when the temperature is completed for all temperatures.

8. Remove probe cover and discard.

9. To clean instruments, simply clean the surface with a soft cloth dampened with isopropyl alcohol. Do not immerse in alcohol or water.

10. To recharge the thermometer, simply place the thermometer on the recharging units.

7. Failure to wait until the light brightens will give you a reading that is inaccurate and too low.

8. Remove the probe cover by the base to ensure that germs or organisms don't transfer to your hands or break the plastic cover. Carrying around a dirty cover transfers those germs to other patients or objects.

9. Cleaning will remove some harmful organisms or germs. Immersing the units in alcohol or water would damage the circuitry in the unit.

10. Recharging the units after approximately 100 temperatures will not slow you down to recharge while you're making rounds taking patient temperatures. It also keeps the thermometers in a readily available place so you don't have to look for them.
PROGRAMMED INSTRUCTION

Directions:

1. Allow the aide to read this for as long as necessary. Do not demonstrate the use of thermometer.

2. Return demonstration. Note pass-fail. Correct error by referring to text and if necessary return demonstration.

1 - 1  The electronic thermometer operates by using a nickel-cadmium battery.

1 - 2  The electronic thermometer is operated.

1 - 3  In order to operate the unit, the parts of the unit must be identified.

- a. the black start button represented on the unit activates the circuitry by pressing on the button and is represented by number 1.
- b. the latch indicator on the unit indicates completion of the temperature-taking process when lighted and is represented by number 2.
- c. the numeral display on the unit indicates the digital read-out of the temperature and is represented by number 3.
- d. the probe takes the temperature and is represented by number 4.

1 - 4  Below is a copy of the electronic thermometer. Identify the parts of the thermometer.

1. start button
2. latch indicator
3. numeral display
4. probe

If you were unable to identify the components properly, refer to instructions in frame 3.
THE PROBE COVER

2 - 1 The probe cover is a paper-covered plastic sheath which is placed all the way to the shoulder of the thermometer. The paper may be removed by twisting only on the perforated line. A separate probe cover must be used for each patient and then discarded. The temperature probe is ready for insertion after the paper cover is removed, leaving the plastic sheath under the paper to cover the probe.

2 - 2 The following statements are true or false about the probe cover:

false The paper may be left on the probe cover to take the temperature.
true A separate probe cover must be used for each patient.
true The paper may be removed correctly by twisting on the dotted line.
The thermometer probe measures the temperatures most accurately by contact with mucosa at the left posterior sublingual pocket represented by number 1. Locate numbers 2, 3, 4, 5, 6, 7, 8, and 9 on the drawings. Note how different the temperatures are.

Which number on the diagram identifies the correct spot for placement of the thermometer?

Which side of the mouth under the tongue is the correct spot for placement of the thermometer?

To take an oral temperature, the following steps are necessary:

a. press the indicator button.

b. check numeral display for read-out of 81.9° F. for standardization. This will change as the room gets warmer or colder.
c. place thermometer probe cover on thermometer, remove cover.

d. place probe slowly into patient's mouth.

e. check to make sure tip of probe is at the posterior sublingual pocket.

f. when latch indicator lights, read temperature from numeral display.

3 - 5 Review the above procedure. Number the order of the procedure for taking temperatures correctly:

b ___ a. place probe slowly into patient's mouth.

e ___ b. press the indicator button.

c ___ c. place thermometer probe cover on thermometer, remove cover.

a ___ d. when latch indicator lights, read temperature from numeral display.

f ___ e. check numeral display for readout of 81.9°F for standardization. This will change as the room gets warmer or colder.

d ___ f. check to make sure tip of probe is at the posterior sublingual pocket.
RECTAL TEMPERATURES

4 - 1 In order to take a rectal temperature, the following steps are necessary:

a. press the indicator button.

b. check the numeral display for read-out of 81.9°F for standardization. This will change as the room gets warmer or colder.

c. place thermometer probe cover on thermometer, remove cover.

d. place probe silver tip slightly past the sphincter muscle about ½ inch and tip slightly.

e. when latch indicator lights, read temperature from numeral display.

4 - 2 Review the above procedure. Number the order of the procedure for taking temperature correctly.

___a. place probe silver tip slightly past the sphincter muscle about ½ inch and tip slightly.

___b. when latch indicator lights, read temperature from numeral display.

___c. press the indicator button.

___d. place thermometer probe cover on thermometer, remove cover.

___e. check the numeral display for read-out of 81.9°F for standardization. This will change as the room gets warmer or colder.
RECHARGING THE THERMOMETER

5 - 1 The thermometer will take approximately 115 readings per battery charge. In order to recharge the battery, simply place the thermometer on the recharger. Do not forget to plug in the recharger.

thermometer

5 - 2 In order to recharge the thermometer, place the ________ on the ________ which is plugged into a wall socket.
CLEANING THE UNIT

6 - 1 The surface of these instruments may be cleaned with a soft cloth dampened with isopropyl alcohol or water. Do not autoclave or immerse any parts.

isopropyl 6 - 2 The correct cleaning agent is ________.
may not Choose the correct answer. Parts may or may not be immersed in alcohol or water.

You now have completed the programmed instruction unit. I'll give you a few questions to determine how well you remember. If you miss any, refer to unit in text.

TRUE - FALSE

false--you may have perforated the rectum. see 4-1,d.

false, see 3-2, 3-3

true, see 3-4, b.

false, see 3-1.

false, see 2-1.

false, see 6-1

true, see 5-1.

true, see 1-3, b.

1. A rectal temperature is taken by inserting the probe the length of the whole probe into the rectum.

2. An oral temperature is taken on the right side of the posterior sublingual pocket.

3. The start button will indicate 81.9° when first pressed.

4. The thermometer probe measures air in the mouth cavity.

5. The paper on the probe cover is left in place after placement all the way to the shoulder of the thermometer.

6. The thermometer may be immersed in water to be cleaned.

7. In order to recharge the battery, simply place the thermometer on the recharger.

8. The latch indicator will light up when the temperature taking is complete.
true, see 2-1.

9. A new probe cover is used for each patient.

true, see 2-1

10. The paper probe cover may be removed by twisting on the dotted line.

Now you are ready to demonstrate the procedure.
CONTROL GROUP

Directions:

1. Demonstrate procedure.
2. Allow student to read material.
3. Ask for return demonstration. Note pass-fail.
4. Posttest.
OPERATING INSTRUCTIONS
Electrotherm Model 18 and Model 24
Battery Operated Electronic Thermometer

The Electrotherm Model 18 or Model 24 electronic thermometer is operated in the following manner:

1. Insert thermometer in probe cover all the way to shoulder of the thermometer. Remove sheath from probe cover by twisting on perforated line. The thermometer is now ready for use.

2. For ORAL temperatures, press button on the thermometer and release immediately prior to insertion. (A reference number of either 81.9°F or 20.4°C will appear on display). Place thermometer probe slowly into patient's mouth, making sure to position tip of probe at posterior sublingual pocket.

3. For RECTAL temperatures, insert silver probe tip slightly past the sphincter muscle (approximately ¼" to ½"). Tip unit slightly so that contact is made with vascular tissue surrounding the sphincter muscle, then activate the unit.

When red light just above numeral display lights up, remove probe, read the temperature on display and record. Remove probe cover and discard. Within 10 seconds thermometer will erase display and reset for reuse.

Additional technical detail will be found on the reverse side.

ELECTROMEDICS, INC.
4905 Nome Street / Denver, Colorado 80239
Phone 303-371-2000
ELECTROMEDICS, INC.
Electrotherm Model 18 and Model 24
Electronic Digital Thermometer & Battery Chargers

MODEL 18

MODEL 24

1. Push to Start Button
2. Latch Indicator
3. Charge Indicator
4. Numeral Display
5. Probe Receptacle
6. Probe
7. Coil Cord

ELECTROTHERM F-18: °F Scale Thermometer
ELECTROTHERM C-18: °C Scale Thermometer
ELECTROTHERM F-24: °F Scale Thermometer
ELECTROTHERM C-24: °C Scale Thermometer
ELECTROMEDICS CB-3: 120 Volt Battery Charger
ELECTROMEDICS CB-12: 120 Volt Battery Charger

SPECIFICATIONS
- Push to Start Switch — activates circuitry; automatic turn-off after final reading displayed — 10 seconds.
- Reference Number — either 81.9°F or 20.4°C.
- Accuracy — ± 0.2°F, ± 0.1°C guaranteed within the range of 90.0°F to 105.0°F, 32.2°C to 40.6°C
- Power — rechargeable nickel-cadmium battery, approximately 115 readings per battery charge.
- Display — temperature is displayed on four numeral seven segment light emitting diodes (LED) which flash while temperature is taken, then intensify and latch for 10 seconds.

CLEANING PROCEDURE
The surface of these instruments may be cleaned with a soft cloth dampened with isopropyl alcohol (greater than 70% by weight) or water. DO NOT autoclave or immerse any parts. Standard gas sterilization techniques can be utilized provided the temperature does not exceed 140°F (60°C) and humidity does not exceed 50%.

WARRANTY
This product has been carefully manufactured from high quality parts and is warranted to be free from defects in materials and workmanship for a period of one year or as long as it is maintained under Electromedics, Inc. Temperature System lease agreement.
The Anatomy
of Oral Thermometry

The exact placement of the sensing element in oral thermometry is not carefully described in elementary nursing texts. They usually state that, "the thermometer shall be placed under the tongue". When the sensor is an excellent heat conductor so that a maximum is always revealed, its shape and size is of less importance, as long as some part is in contact with the area of highest temperature. When, however, the sensor is small, exact placement is imperative. Placement must remain until the entire sensing instrument has reached an equilibrium with the contact tissue.

Figure 1

A diagram of the floor of the mouth indicating the location of the "Heat Pockets" at the base of the tongue.
1. The electronic thermometer measures:
   a. air temperature.
   b. tissue temperature.
   c. bone temperature.
   d. none of the above.

2. The best place to take an oral temperature with an electronic thermometer is:
   a. in the left anterior sublingual pocket.
   b. in the right anterior sublingual pocket.
   c. in the left posterior sublingual pocket.
   d. in the right posterior sublingual pocket.

3. The standardization number on an electronic thermometer is:
   a. 81.9° F.
   b. 92.6° F.
   c. 98.6° F.
   d. 96.4° F.

4. The electronic thermometer can be cleaned best by:
   a. immersing the unit in water.
   b. immersing the unit in alcohol.
   c. using a soft cloth dampened with phisohex.
   d. using a soft cloth dampened with alcohol.

5. The paper sheath on the probe cover:
   a. never needs to be removed.
   b. can be removed and discarded.
   c. is necessary for heat sensing.
   d. none of the above.

6. For rectal temperatures, the silver probe:
   a. should be inserted as far as possible.
   b. should be inserted ½-inch past the sphincter.
   c. should not be inserted.
   d. should be inserted two inches past the sphincter.
7. When the red light above the numeral display lights up, it means:
   a. the battery needs charging.
   b. the temperature is ready to be read.
   c. the unit is not functioning correctly.
   d. none of the above.

8. A probe cover should:
   a. never be used.
   b. used for each patient.
   c. used for a whole group of patients without being charged.
   d. never be used for oral temperatures.

9. The temperature unit is activated:
   a. by pressing the black button under the digital read-out.
   b. by pressing the red button under the digital read-out.
   c. by pressing the red button over the digital read-out.
   d. none of the above.

10. Units may be recharged by:
    a. changing batteries within the unit.
    b. never need recharged.
    c. placing the unit on the recharger.
    d. are not recharged, but are discarded.

11. Units must be recharged:
    a. never need recharged.
    b. after about 100 readings.
    c. after about 50 readings.
    d. if the digital read-out appears dim.

12. The temperature-taking unit will:
    a. automatically turn-off after final readings are displayed.
    b. continuously flash the reading until reset.
    c. automatically flash the standardized reading unless reset.
    d. none of the above.
13. The glass thermometer is:
   a. more accurate than the electronic thermometer.
   b. less accurate than the electronic thermometer.
   c. no difference between the two.
   d. accuracy varies according to thermometer and reader.

14. The electronic thermometer takes temperature:
   a. more quickly than glass thermometer.
   b. less quickly than glass thermometer.
   c. about the same speed.

15. Temperature is displayed by the unit:
   a. on a digital read-out.
   b. on a regular, graded scale.
   c. on the probe receptacle.
   d. on the latch indicator.

16. The electronic thermometer can take temperatures:
   a. orally only.
   b. orally and rectally.
   c. rectally only.

17. The anterior sublingual area is:
   a. warmer than the posterior sublingual area.
   b. cooler than the sublingual area.
   c. there is no difference between areas.
   d. varies either warmer or colder than the posterior sublingual area.

18. The probe cover:
   a. should cover only the silver metal tip.
   b. should cover only the first two inches of the probe.
   c. should cover the probe all the way to the shoulder of the thermometer.
   d. one of the above.

19. When inserting the probe into the rectum:
   a. tip slightly so contact is made with tissue.
   b. enter at a right angle for better control.
   c. enter straight line to measure air temperature.
   d. none of the above.
20. The paper sheath may be removed best from the probe cover by:
   a. holding the top and tearing.
   b. holding the center section and tearing down the middle.
   c. twisting on perforated line.
   d. all of the above.

21. The latch indicator will ___________ when temperature taking is complete.
   a. do nothing.
   b. flash a digital read-out.
   c. light.
   d. beep.

22. According to the drawings of the mouth,
   a. the left sublingual pocket is warmer than the right.
   b. the right sublingual pocket is warmer than the left.
   c. the front pockets of the mouth are warmer than the back pockets.
   d. the right sublingual pocket is the same temperature as the left sublingual pocket.

23. The part of the electronic thermometer which actually takes the temperature is:
   a. the probe.
   b. the latch indicator.
   c. the thermostat.
   d. none of the above.

24. The standardization read-out will:
   a. get adjusted to warmness or coolness of the room.
   b. never change as it is a standard read-out.
   c. be correct if the battery is not charged.
   d. none of the above.

25. The thermometer recharger unit is:
   a. battery operated.
   b. must be plugged into a wall socket.
   c. filled with an electronegative solution for charging.
   d. all of the above.
APPENDIX B
TABLE I

PILOT STUDY TEST ANALYSIS

<table>
<thead>
<tr>
<th>Test Items</th>
<th>Programmed</th>
<th>Control</th>
<th>Teacher-Taught</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dif.*</td>
<td>Disc.**</td>
<td>Dif.*</td>
</tr>
<tr>
<td>1</td>
<td>.76</td>
<td>.40</td>
<td>.68</td>
</tr>
<tr>
<td>2</td>
<td>.90</td>
<td>.10</td>
<td>.74</td>
</tr>
<tr>
<td>3</td>
<td>.86</td>
<td>.20</td>
<td>.66</td>
</tr>
<tr>
<td>4</td>
<td>.81</td>
<td>.20</td>
<td>.42</td>
</tr>
<tr>
<td>5</td>
<td>.81</td>
<td>.30</td>
<td>.84</td>
</tr>
<tr>
<td>6</td>
<td>.81</td>
<td>.30</td>
<td>.58</td>
</tr>
<tr>
<td>7</td>
<td>.90</td>
<td>.20</td>
<td>.68</td>
</tr>
<tr>
<td>8</td>
<td>.95</td>
<td>.10</td>
<td>.53</td>
</tr>
<tr>
<td>9</td>
<td>.90</td>
<td>.00</td>
<td>.42</td>
</tr>
<tr>
<td>10</td>
<td>.76</td>
<td>.40</td>
<td>.37</td>
</tr>
<tr>
<td>11</td>
<td>.86</td>
<td>.20</td>
<td>.53</td>
</tr>
<tr>
<td>12</td>
<td>.86</td>
<td>.20</td>
<td>.68</td>
</tr>
<tr>
<td>13</td>
<td>.86</td>
<td>.20</td>
<td>.58</td>
</tr>
<tr>
<td>14</td>
<td>.81</td>
<td>.30</td>
<td>.42</td>
</tr>
<tr>
<td>15</td>
<td>.81</td>
<td>.30</td>
<td>.44</td>
</tr>
<tr>
<td>16</td>
<td>.95</td>
<td>.10</td>
<td>.47</td>
</tr>
<tr>
<td>17</td>
<td>.86</td>
<td>.20</td>
<td>.68</td>
</tr>
<tr>
<td>18</td>
<td>.95</td>
<td>.10</td>
<td>.68</td>
</tr>
<tr>
<td>19</td>
<td>1.00</td>
<td>.00</td>
<td>.47</td>
</tr>
<tr>
<td>20</td>
<td>.86</td>
<td>.20</td>
<td>.58</td>
</tr>
<tr>
<td>21</td>
<td>.86</td>
<td>.20</td>
<td>.58</td>
</tr>
<tr>
<td>22</td>
<td>.95</td>
<td>.10</td>
<td>.79</td>
</tr>
<tr>
<td>23</td>
<td>.87</td>
<td>.30</td>
<td>.84</td>
</tr>
<tr>
<td>24</td>
<td>1.00</td>
<td>.00</td>
<td>.68</td>
</tr>
<tr>
<td>25</td>
<td>.90</td>
<td>.20</td>
<td>.63</td>
</tr>
</tbody>
</table>

*Difficulty index is the proportion answering the item correctly: 1.00, all correctly answered; .00 none answered correctly; .50 represents an item which will produce the maximum variance.

**Discrimination notes the difference in the performance of the student who scored the highest grades on the tests and the student who scored the lowest grade on the test: 1.00 denotes all of the high group and none of the low group answered the question correctly; .00 denotes that there was no difference between the performance of the high group and the low group.
TABLE II
GROUP MEANS

<table>
<thead>
<tr>
<th>Test</th>
<th>Teacher-Taught</th>
<th>Programmed</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.25</td>
<td>6.20</td>
<td>6.263</td>
</tr>
<tr>
<td>2</td>
<td>19.750</td>
<td>21.550</td>
<td>15.000</td>
</tr>
<tr>
<td>3</td>
<td>18.600</td>
<td>19.350</td>
<td>10.263</td>
</tr>
<tr>
<td>4</td>
<td>19.250</td>
<td>18.250</td>
<td>9.684</td>
</tr>
</tbody>
</table>

TABLE III
ANOVA SUMMARY

<table>
<thead>
<tr>
<th>Source</th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSAG</td>
<td>59</td>
<td>3766.54688</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>2</td>
<td>2493.97266</td>
<td>1246.98633</td>
<td>55.85391*</td>
</tr>
<tr>
<td>BSSG</td>
<td>57</td>
<td>1272.57422</td>
<td>22.32585</td>
<td></td>
</tr>
<tr>
<td>WSAG</td>
<td>180</td>
<td>9513.75000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR</td>
<td>3</td>
<td>5621.57422</td>
<td>1873.85791</td>
<td>105.23726**</td>
</tr>
<tr>
<td>BXT</td>
<td>6</td>
<td>900.76172</td>
<td>150.12695</td>
<td>8.43125***</td>
</tr>
<tr>
<td>STXG</td>
<td>168</td>
<td>2991.41406</td>
<td>17.80603</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>239</td>
<td>13280.29688</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant difference between groups over tests.
**Significant difference between tests over groups.
***Significant test times group interaction.
### TABLE IV
ANALYSIS OF VARIANCE OF YEARS WORKED

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>1.3000002</td>
<td>2</td>
<td>.65000010</td>
<td>.414</td>
<td>.66314*</td>
</tr>
<tr>
<td></td>
<td>1.3000002</td>
<td>2</td>
<td>.65000010</td>
<td>.414</td>
<td>.66314*</td>
</tr>
<tr>
<td>Explained</td>
<td>1.3000031</td>
<td>2</td>
<td>.65000153</td>
<td>.414</td>
<td>.66314</td>
</tr>
<tr>
<td>Residual</td>
<td>89.549606</td>
<td>57</td>
<td>1.5710449</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>90.848609</td>
<td>59</td>
<td>1.5398235</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Not significant.

### TABLE V
ANALYSIS OF VARIANCE FOR AGE OF RESPONDENT

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Square</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Effects</td>
<td>.23333335</td>
<td>2</td>
<td>.11666667</td>
<td>.152</td>
<td>.85919*</td>
</tr>
<tr>
<td>Group</td>
<td>.23333335</td>
<td>2</td>
<td>.11666667</td>
<td>.152</td>
<td>.85919*</td>
</tr>
<tr>
<td>Explained</td>
<td>.23333740</td>
<td>2</td>
<td>.11666870</td>
<td>.152</td>
<td>.85918*</td>
</tr>
<tr>
<td>Residual</td>
<td>43.699722</td>
<td>57</td>
<td>.76666176</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>43.933060</td>
<td>59</td>
<td>.74462807</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Not significant.
### TABLE VI

**ANALYSIS OF VARIANCE FOR SEX OF RESPONDENT**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Effects</td>
<td>.43333334</td>
<td>2</td>
<td>.21666664</td>
<td>1.051</td>
<td>.35624*</td>
</tr>
<tr>
<td></td>
<td>.43333334</td>
<td>2</td>
<td>.21666664</td>
<td>1.051</td>
<td>.35624*</td>
</tr>
<tr>
<td>Explained</td>
<td>.43333340</td>
<td>2</td>
<td>.21666670</td>
<td>1.051</td>
<td>.35624*</td>
</tr>
<tr>
<td>Residual</td>
<td>11.749977</td>
<td>57</td>
<td>.20613992</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12.183311</td>
<td>59</td>
<td>.20649678</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Not significant.

### TABLE VII

**ANALYSIS OF VARIANCE OF EDUCATIONAL LEVEL**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Effects</td>
<td>1.8999996</td>
<td>2</td>
<td>.94999981</td>
<td>1.090</td>
<td>.34327*</td>
</tr>
<tr>
<td></td>
<td>1.8999996</td>
<td>2</td>
<td>.94999981</td>
<td>1.090</td>
<td>.34327*</td>
</tr>
<tr>
<td>Explained</td>
<td>1.9000092</td>
<td>2</td>
<td>.95000458</td>
<td>1.090</td>
<td>.34327*</td>
</tr>
<tr>
<td>Residual</td>
<td>49.699677</td>
<td>57</td>
<td>.87192410</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>41.499686</td>
<td>59</td>
<td>.87457091</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Not significant*
### TABLE VIII

**ANALYSIS OF VARIANCE FOR ETHNIC GROUP**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Effects Group</td>
<td>.43333334</td>
<td>2</td>
<td>.21666664</td>
<td>.984</td>
<td>.3805*</td>
</tr>
<tr>
<td>Explained</td>
<td>.43333340</td>
<td>2</td>
<td>.31666670</td>
<td>.984</td>
<td>.3805*</td>
</tr>
<tr>
<td>Residual</td>
<td>12.549973</td>
<td>57</td>
<td>.22017491</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12.983306</td>
<td>59</td>
<td>.22005600</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Not significant.

### TABLE IX

**ANALYSIS OF VARIANCE OF ENGLISH AS PRIMARY LANGUAGE**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Effects Group</td>
<td>.00000000</td>
<td>2</td>
<td>.00000000</td>
<td>.000</td>
<td>.99999*</td>
</tr>
<tr>
<td>Explained</td>
<td>.00000000</td>
<td>2</td>
<td>.00000000</td>
<td>.000</td>
<td>.99999*</td>
</tr>
<tr>
<td>Residual</td>
<td>.00000000</td>
<td>57</td>
<td>.00000000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>.00000000</td>
<td>59</td>
<td>.00000000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Not significant.*
### TABLE X

DISTRIBUTION OF EACH VARIABLE

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fail</th>
<th>Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>44</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>49</td>
</tr>
</tbody>
</table>

### TABLE XI

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chi Square</th>
<th>Degree of Freedom</th>
<th>Probability</th>
<th>Contingency Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60.000</td>
<td>1</td>
<td>.0000</td>
<td>.71</td>
</tr>
<tr>
<td>2</td>
<td>13.067</td>
<td>1</td>
<td>.0006</td>
<td>.42</td>
</tr>
<tr>
<td>3</td>
<td>24.067</td>
<td>1</td>
<td>.0000</td>
<td>.54</td>
</tr>
<tr>
<td>4</td>
<td>24.067</td>
<td>1</td>
<td>.0000</td>
<td>.54</td>
</tr>
</tbody>
</table>

### TABLE XII

DISTRIBUTION OF STUDENTS PASSING SKILL TEST

<table>
<thead>
<tr>
<th>Group</th>
<th>Test 1 No. Passed</th>
<th>Test 2 No. Passed</th>
<th>Test 3 No. Passed</th>
<th>Test 4 No. Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programmed</td>
<td>0</td>
<td>20</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Teacher-Taught</td>
<td>0</td>
<td>16</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>10</td>
<td>13</td>
<td>17</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY

Books


75


Ramsay, James G., Concept Learning as a Function of the Type of Material and Type of Classification. University of Wisconsin, Madison Research and Development Center for Cognitive Learning, June, 1968.


Articles


Baller, William, "Note on Difficulty of Material and Delay of Knowledge of Results," Psychology Reports, XXVI (April, 1970), 377-378.


Freake, R., "Should Time & Temperature be Quality Controlled?" American Journal of Medical Technology, XXXV (June, 1969), 345-352.


Marx, Melvin H., "Increased Probability of Error Repetition As a Function of Number of Successive Prior Repetitions," Perceptual and Motor Skills, XXXII (April, 1971), 544-546.


Tate, G.V., "Correct use of Electric Thermometers," American Journal of Nursing, LXX (September, 1970), 1898-1899.


Tessena, A., "Processing and Redistributing Thermometers," Hospital Management, CIX (June, 1970), 49.

Verhonick, P.J., "Temperature Measurement in Nursing Practice and Research," Canadian Nurse, LXIV (June, 1968), 41-44.


---


