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EFFECTIVENESS OF A SELF-INSTRUCTIONAL PROGRAM TO PREPARE HOME ECONOMICS TEACHERS TO TEACH PUPILS TO APPLY GENERALIZATIONS

by

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The purpose of this experiment was to determine the effectiveness of a self-instructional program to prepare home economics teachers to teach pupils to apply given generalizations. The criterion of effectiveness was a paper and pencil test in two equivalent forms developed to measure the ability of pupils to apply generalizations. One test was administered by the researcher immediately following the teaching of a three-week foods unit which was limited to generalizations concerning the preparation of vegetables, quick breads, and starch sauces and puddings to a ninth-grade home economics class. An equivalent form of the immediate post test was administered by the researcher three weeks later to test retention. The immediate post test had a coefficient of reliability greater than .91 determined from scores of 104 ninth-grade pupils. The product moment coefficient of reliability between the two tests was .95.

The experiment was a two-factor design. Each factor involved three groups making a three-by-three table with nine cells. The first factor, teacher preparation, had these three treatment groups: I, six teachers given the self-instructional program and a list of generalizations; II, six teachers given a list of generalizations but no program; and III, six teachers given neither program nor generalizations. The second factor, teaching experience, involved three levels: one to four years, five to nine years, and ten or more years.

The eighteen subjects were a stratified random sample of teachers who were selected from the entire population of vocational home economics

teachers within sixteen North Carolina counties within a 100 mile radius of Greensboro, North Carolina. The experiment was replicated by randomly assigning two teachers to each of the three treatment groups within each of the three levels of teaching experience. There was a total of 242 pupils in the eighteen classes.

A pilot study simulating the treatment of Group I--program and the generalizations--was carried out in the same geographic area in which the experiment was conducted. No changes were made in the design of the experiment as a result of the pilot study.

The analysis of covariance was used for data analysis, the covariate being grade point average of the pupils. The data used for analysis were the scores of the pupils on the immediate post test and the retention test. Since each treatment involved two parts, orthogonal comparisons were made to determine (1) the effect of the program and (2) the effect of the generalizations. The effect of the level of teaching experience was determined also. An analysis was made to determine the interaction between (1) whether or not the teacher had the program and the level of teaching experience and (2) whether or not the teacher had the generalizations and the level of teaching experience.

The analysis of the data showed that significant differences were found in the comparison of mean scores on both criterion measures of the pupils whose teachers did or did not have the generalizations. The direction of the scores favored the teachers who had the generalizations. A second finding was that there were no significant differences in scores of pupils whose teachers

did or did not have the program. The direction of the scores favored the teachers who had the program. The third finding was that there were no significant differences among levels of teaching experience. However, the mean scores of pupils of teachers who had from one to four years of teaching experience were higher than the scores of pupils of teachers in the other two levels. The fourth finding was that there were no significant interactions, although the mean scores of pupils whose teachers were given the program and had from one to four years of teaching experience were considerably higher than the mean scores in the other eight cells.

There were greater differences among the six teachers who were within one treatment group than there were among the three treatment groups. This large experimental error was a contributing factor to the results of the experiment. The significant difference between mean scores of pupils of teachers who did or did not have the generalizations was not of importance. The test was made from the given generalizations. The pupils of the teachers who did not receive the generalizations probably studied a different part of the subject matter which could have contributed to their lower scores.

One conclusion was that the self-instructional program did not prepare the teachers to teach their pupils in such a way that the pupils could score higher on a written test of application of generalizations than pupils whose teachers did not have the program when both sets of teachers had the generalizations. Another conclusion reached was that the level of teaching experience does not alter the teacher's effectiveness in teaching pupils to

apply generalizations. This study supported prior studies in which it was found that teachers using the same method differ widely in their ability to teach when the ability is measured by a written test.

APPROVAL SHEET

This dissertation has been approved by the following committee of the Faculty of the Graduate School of the University of North Carolina at Greensboro, Greensboro, North Carolina.

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CHAPTER I

INTRODUCTION

The Importance of Teaching Pupils to Apply Generalizations

Recent concern with identifying basic concepts and generalizations has caused a concurrent interest in studying the processes of teaching for conceptual understandings and the application of these understandings outside the classroom. This concern has occurred in most subject matter fields. Tyler said at the annual American Home Economics Association meeting in 1962 that

> in home economics, as in all fields, emphasis will need to be given to understanding basic principles and the development of ability to apply these principles to new situations as they are encountered (Tyler, 1962, p. 533).

Tyler (1962, p. 531) said that emphasis on understanding and applying basic principles is important because of the "kind of flexibility, adaptability, and continued learning concurrently required . . ." in living. Other educators besides Tyler have been advocating that pupils be prepared to transfer or apply what they learn in school to situations they find in life. Dressel (1961, p. 7), consultant for a college-level home economics seminar, said that the graduate must react to situations different from those studied in school. He went on to say that learning generalizations permits an individual to deal more intelligently with these new situations (Dressel, 1961, p. 12). Woodruff (1961, p. 131)

stated that pupils become better problem-solvers in life, only when they have a foundation of organized knowledge in the form of concepts and principles or generalizations. Gagné (1965, p. 237) was in agreement with Tyler, Dressel, and Woodruff when he wrote that productive members of society are those who can transfer knowledge from the classroom to the world outside the classroom. He suggested that this transfer could be effected by supplying a pupil with a background of basic concepts and principles and by supplying much classroom experience in applying these concepts and principles to new situations (Gagné, 1965, pp. 255-56).

Research Needed on How to Teach Pupils to Apply Generalizations

When authorities say that knowledge will transfer if pupils are taught basic concepts and generalizations and in addition are taught how to apply them, research appears to be warranted for determining whether such teaching is possible. Bruner (1961, p. 32) encouraged research in methods of teaching pupils to meet the challenges of today. He did not limit the research to methods of classroom teaching which would be most effective in high school but encouraged research in methods of teacher education. Many authorities have suggested that research is needed concerning the methods to use in teaching for knowledge application and for finding ways to educate teachers for the best use of these methods in the classroom (Bruner, 1961; Duncan, 1959; Gagné and Bolles, 1959; Hendrix, 1947; Shulz, 1960; and Spence, 1959).

Some writers specifically have stated that courses in educational

methods must be concerned with teaching for application of generalizations about how to teach. In their book Burton, Kimball, and Wing (1960, p. 6) censured teacher education departments for the inability of teachers to transfer knowledge to their classrooms. Bruner (1961, p. 27) emphasized that the kinds of training needed by teachers for teaching their pupils to apply knowledge are not clear. Amidon (1960, p. 630) prodded home economics subject matter specialists and home economics educators, in particular, to cooperate in finding ways to change methods to meet present demands.

These challenges were the reason for planning the present research. Teachers need specific methods for teaching their pupils to formulate and apply generalizations. Teachers also need to be taught specifically how to use these methods in their own classrooms.

Statement of the Problem

The main objective of the present study was to appraise the effectiveness of one self-instructional program for teachers by means of a criterion of effectiveness believed by some authorities to be one of the most rigorous of all such criteria. The self-instructional program was designed to guide teachers to teach their pupils to formulate and to apply generalizations (Johnson, 1966). Since this self-instructional program was planned to teach one particular method for teachers to use with high school classes, the evaluation of the program and the evaluation of the method of teaching presented in the program could not be separated. This inability to separate two parts of an independent variable

is known statistically as "confounding."

Educators believe that one way to measure a pupil's ability to apply generalizations is to measure the extent to which he applies the generalizations when presented with written problems which would require such application. Hence, the criterion of effectiveness of the program and of the method the program presented was measured by the accuracy of answers pupils gave to test items of the problem-solving type. Educators believe that a pupil's responses to test questions are indicative of what the pupil has learned.

"Application" according to the committee that developed the Taxonomy of Educational Objectives (Bloom, ed., 1956, p. 122), is the use of generalizations in making correct responses to situations new to the pupil. "New" means a situation that the pupil has not encountered in class, but one which fits into the category of situations used for teaching the understanding, formulation, and application of a generalization.

The objective of the present research required a field experiment to determine whether pupils can apply specified generalizations when their teachers have completed the self-instructional program prior to teaching the generalizations to their pupils.

The hypothesized outcome of the present research was that the pupils of teachers who had completed this particular self-instructional program would obtain higher scores on an application of generalizations test than would the pupils of teachers who had not had the self-instructional program.

Background for This Experiment

National Efforts to Improve Preparation of Teachers

For a long time some leaders in the field of home economics had been aware of the need to prepare teachers to guide pupils to state and apply generalizations. A concerted effort toward meeting this need occurred when an appointed committee developed Home Economics New Directions which was published by the American Home Economics Association in 1959. Based on the philosophy and objectives that the understanding and application of basic principles of the discipline be emphasized, twelve competences were suggested which home economics teachers should teach. An immediate result of the publication was the use of the twelve competences as guidelines for program planning (Alexander and Hill, 1960, p. 83). Thereafter, writers began to indicate the need for improved teaching methods which would develop the ability to formulate and apply generalizations (Ayers, 1960, p. 503).

The development of materials for teaching pupils to formulate and apply generalizations began in some states even before the publication of the 1959 New Directions. Amidon (1960), in an article enumerating some efforts already underway which could be a basis for implementing the means to these objectives, noted that during the 1950's teachers and state supervisors in Iowa had developed materials "to help students formulate basic principles, drawing on situations that have meaning for them." These persons also worked on methods to help the pupils develop skill in applying these principles to new

problems. Evaluation specialists in home economics education at the Iowa State University developed test items based on the principles and generalizations identified by teachers and supervisors (Amidon, 1960, p. 627).

More than a year before Tyler's speech at the American Home Economics Association convention, in which he encouraged teachers to teach for the formulation and application of generalizations, representatives of the Home Economics Branch of the United States Office of Education called a meeting of selected home economics educators to identify basic concepts and generalizations for teaching at the secondary level (United States Office of Education, 1961). During the same year, the Home Economics Division of the Association of State Universities and Land Grant Colleges sponsored a meeting for college teachers to which consultants from the United States Office of Education (hereafter referred to as the U.S.O.E.) were invited to discuss a problem for which there had been a growing concern--articulation of curricular content at the secondary, adult, and college levels.

The two meetings mentioned above were the springboard for several subsequent meetings called by the U.S.O.E. at which representatives from each subject matter area in home economics participated. These meetings were a part of the National Curriculum Study in home economics. A culmination of the thinking at the meetings was a list of concepts and generalizations printed in the form of working papers for use by administrators in home economics (U.S.O.E., 1965). From 1961 to the present time, home economics educators have been attempting to apply the suggestions from the National

Curriculum Study to the teaching of home economics on all levels. A revised structure of home economics education in which the teaching of application of generalizations to pupils is included has been distributed for use by college teachers of home economics education (U.S.O.E., 1966).

Research from Which the Present Experiment Evolved

The adviser for the present research was a student of and later a co-worker of home economics evaluation specialists at the Iowa State University when these specialists were developing items to test ability of pupils to apply generalizations. This background, coupled with recent experience in writing self-instructional programs, spurred the adviser to write a program to help teachers teach their pupils to formulate and apply generalizations (Johnson, 1966). The development and description of this self-instructional program are presented in Chapter III. Although this program was written for the pre-service teacher, Johnson realized that its effectiveness could be evaluated through a field experiment in which in-service teachers were involved. The appraisal of this particular self-instructional program was the purpose of the present research.

Clarification of Terms Used

The struggle to define concepts and generalizations was quite difficult for the participants in the National Curriculum Study. Identification of basic concepts and generalizations in the field of home economics was equally

difficult. Considerable effort was devoted to differentiating the terms "concept," "generalization," and "principle." Since the self-instructional program used in this experiment is concerned only with preparing teachers to teach for the formulation and application of generalizations, the terms "concept" and "principle" will not be included in the definitions. The phrases "formulation of a generalization" and "application of a generalization" are used in this study in preference to the term "generalize." "Transfer" and "application" are used synonymously in this report. Terms, as used in this study, are defined below.

Generalization. --A generalization is a statement which expresses an underlying truth, has an element of universality, and usually indicates relationships (U.S.O.E., 1965). The statement of a generalization shows some relationship between two or more concepts, is supported by facts, and applies to a number of situations (Brownell, 1950, p. 117).

Formulation of a generalization. --A generalization is formulated when a person perceives the relationships or common attributes between two or more examples and expresses the relationship or commonality in a written or oral statement.

Application of a generalization. --The generalization is applied when a solution to a new problem-situation is found because of the use of the appropriate generalization.

Self-instructional program. --A self-instructional program is a teaching device developed to attain specific behavioral objectives. These objectives are used as the basis for organizing and sequencing subject-matter into a tentative

form of the program, which is then empirically developed into final form by a cycle of individual student try-out and revision by the programmer. A group trial follows the last revision from individual try-outs (Brethower, et al., 1964, p. 236).

Intrinsic program.--An intrinsic program is one in which the reader responds to multiple alternatives.

Linear program.--A linear program is a program in which the reader responds by completing a sentence, constructing an answer, or performing a task.

Assumptions

In this study, it was assumed that a written test of application of generalizations administered to pupils could be used as one measure of the teacher's effectiveness in teaching pupils to apply generalizations. This assumption was consistent with the common assumption in education that learning by the teacher is reflected in the performance of pupils. In the present study, test scores of pupils were used to measure the effect of the teacher's having completed the self-instructional program (Johnson, 1966). This procedure was similar to the procedure in other studies in which teachers are taught certain methods and they, in turn, teach a class. Their pupils are tested to determine whether the scores made on a test vary from scores of pupils in a class taught by a teacher who did not use that method. When there is a significant difference in the test scores, it is assumed to be caused by the

learning of the teacher and her application of this learning in the classroom.

It was assumed also that the method taught by the program is applicable to all areas of home economics. The foods area was chosen for this experiment.

Limitations

The limitations for this research were geographic area, subject matter content to be studied by the pupils, selected generalizations, and the length of time teachers could devote to teaching the unit.

Sixteen North Carolina counties within a one hundred mile radius of Greensboro, North Carolina, were selected. The names of all the vocational home economics teachers within these counties were listed. A stratified random sample was drawn from those teachers who had at least one year of teaching experience, who were teaching one or more sections in first-year home economics, and who would be teaching a foods unit on that level between the beginning of the second semester of the school year 1966-67 and April 1, 1967.

The unit of study to be taught by the teachers was foods. The foods unit was selected because there are more generalizations which are widely accepted and more concrete examples readily available to teachers in that unit than in some of the other areas of home economics. This unit was further limited to the teaching of certain generalizations concerning the preparation of vegetables, quick breads, and starch sauces and puddings. The teachers were asked to limit the unit to fifteen class periods.

Generalizations concerning the preparation of these three foods were limited to the depth generally taught in the first year of home economics in North Carolina. The test was designed and assumed to measure pupil ability to apply generalizations learned in the classroom in an effort to evaluate the teacher's effectiveness in teaching pupils to apply generalizations.

Organization of This Dissertation

Following this chapter will be a review of the literature in four areas: (1) hierarchies of educational objectives, (2) psychological bases for the application of generalizations, (3) methods for teaching pupils to formulate and apply generalizations, and (4) preparation of teachers.

A separate chapter is devoted to the development of (1) the self-instructional program, (2) the list of generalizations, and (3) the criterion instruments.

A chapter describing the experimental procedures used will include discussion of the development of the design of the experiment and a description of the pilot study. The analysis of the data in Chapter V will include both statistical and non-statistical treatment. A summary and conclusions chapter completes the report.

CHAPTER II

REVIEW OF RELATED LITERATURE

The importance of teaching methods which stimulate students to use higher mental processes has had wide discussion in the literature for a number of years. There was no lack of information available. For this reason, this review is limited to the highest level of mental processes measured by the criterion instruments used in the present study. This particular level is application of generalizations.

The review is divided into four parts. Part one is a review of the various ways the higher mental processes have been categorized. Part two includes a review of the literature concerned only with the psychological bases for application of generalizations, frequently referred to as "transfer." In part three, the methods that teachers are encouraged to use in teaching for application of generalizations are reviewed. Part four is a review of how teachers may be prepared to teach their pupils to apply generalizations.

Part I: Levels of Higher Mental Processes

One particular publication devoted to the levels of mental processes has caused a considerable change in the thinking of educators in the last decade. The publication is the Taxonomy of Educational Objectives, Handbook I: Cognitive Domain (Bloom, ed., 1965). This publication is reviewed first

because of its unique position in the chronological order of research and thinking about higher mental processes. The Taxonomy was the result of numerous efforts to name and locate levels of cognitive processes. It was also the starting point for research to justify the taxonomic and hierarchical structure of mental processes and to apply knowledge of the levels to both teaching and evaluation.

The idea for the classification system was formed by a group of college examiners at the American Psychological Association Convention in 1948. The group wished to provide a hierarchy of educational goals with which to evaluate the level of thinking a student had attained; the group believed that a taxonomy would be invaluable for use by teachers when planning the level of thinking to be expected of their students (Bloom, ed., 1956, p. 4).

The assumption was made by the committee that developed the taxonomy that the classes of behavior are the same for students in all subjects and on all levels of education (Bloom, ed., 1956, p. 12). For example, synthesizing of previously learned facts or principles may occur in grade two or ten. It may be synthesis of spelling and reading in the composition of simple sentences in grade two, or it may be synthesis of genetic principles which account for height of an individual in grade ten.

The intended behaviors described in this taxonomy represented social goals of education rather than behaviors which psychologists study and classify (Bloom, ed., 1956, p. 13). Of the various publications reviewed, only one used a psychological classification (Gagné, 1965).

For many decades higher forms of learning or higher mental processes have been described as "critical thinking," "reflective thinking," or "problem-solving." Not until the Taxonomy was published were these terms subdivided into levels of the higher mental processes which are hierarchical and taxonomic. "Hierarchical" means rank order, and in the Taxonomy subsumption of the lower levels under each successively higher level. In other words, to be able to carry out the highest level of thinking in the hierarchy, there is the prerequisite of ability to carry out successively lower levels. The word "taxonomic" means classification in that the various educational objectives could be placed in a certain category. The committee named the whole area of mental processes the "Cognitive Domain." They noted that this domain may include what many people call remembering, reasoning, problem-solving, concept formation, and to a limited extent, thinking (Bloom, ed., 1956, p. 15).

Since complex objectives build on the simpler objectives, the committee said that "one may take the Gestalt point of view that the complex behavior is more than the sum of the simpler behaviors" (Bloom, ed., 1956, p. 16). They also said that "one may view the complex behaviors as being completely analyzable into simpler components," much as behavioral psychologists do (Bloom, ed., 1956, p. 16).

The problem of developing a hierarchy and a taxonomy was that no psychological theory was found at that time to account for a taxonomy. The major classifications upon which the committee agreed are listed below. Each category was further subdivided into a number of classes.

1.00 Knowledge
2.00 Comprehension
3.00 Application
4.00 Analysis
5.00 Synthesis
6.00 Evaluation

"Knowledge" was defined as little more than remembering an idea in a form very close to that in which it was originally encountered. Sub-classes of the knowledge category ranged from the simple to the complex or from the concrete to the abstract. Knowledge as an educational objective was justified by the fact that it is a prerequisite for the attainment of all levels of learning which are above knowledge in the hierarchy (Bloom, ed., 1956, pp. 28-32).

The categories from Comprehension through Evaluation were called intellectual abilities and skills. Few teachers believe that acquisition of knowledge is the sole purpose of education. The committee which developed the Taxonomy said, "Our general understanding of learning theory would seem to indicate that knowledge which is organized and related is better learned and is better retained than knowledge which is specific and isolated." Justification for the division of intellectual abilities and skills was based on studies in which greater retention and transfer occurred when the student applied, analyzed, synthesized and evaluated knowledge in the process of problem-solving (Bloom, ed., 1956, pp. 35-39).

Studies Which Were Directly Related to the Development of a Taxonomy of Mental Processes

The thinking of Judd and Tyler was similar to that expressed in the Taxonomy. Tyler was given much credit for the development of the structure presented in the Taxonomy. Some books published before 1956 will be reviewed in the text that follows. The books selected intimated that the mental processes were hierarchical.

Judd (1915, p. 73) implied that aspects of thinking were hierarchical when he said, "Reasoning involves memory and classification of experiences and the combining of experiences which belong together in leading to a definite conclusion." He also mentioned that some psychologists and educators were saying that memory and reasoning were different forms of learning. Judd (1915, p. 77) however, continued to write that memory and reasoning are not psychologically opposed to each other because memory is necessary for reasoning.

In a later book Judd (1927, p. 530) wrote that forms of learning are different and some are lower than others. The lowest form is ideational acquisition or learning of names. He said these ideas should be systematically arranged in general categories. Judd (1927, p. 344) stated that abstraction and generalization are higher forms of thought which are not possible until the mind has progressed beyond early and immature stages of learning.

Analysis, according to Judd (1927, p. 344), is the process used to discover essential elements from specific examples for abstraction. Analysis

is also said to be the process used in stimulating ". . . search for the same factors in situations other than those in which these elements were first discovered." The first description of analysis is similar to the definition given in this dissertation for formulation of a generalization. Judd's second description of analysis is similar to the definition given in this dissertation for application of a generalization.

Although Judd did not describe the mental processes in the same words as those found in the Taxonomy, the similarities are evident. Judd's "factual knowledge" or "ideational acquisition" are comparable to the classification "knowledge" in the Taxonomy. Judd's process of "abstraction" is similar to the process called "comprehension" in the Taxonomy, and the process of "generalization" is similar to "application" and possibly some of the higher classifications in the Taxonomy. Judd's use of the term "analysis" is not synonymous with the classification of "analysis" in the Taxonomy.

The Carnegie Foundation funded a study to determine methods for leading students to develop generalizations and to think conceptually. The entire study was reported by Judd in 1936. One of the studies was conducted and reported by Tyler (Judd, 1936, pp. 6-17).

Tyler's study was carried out at Ohio State University in 1932. The purpose was to compare a college student's success in the recall of information with his success in carrying on higher mental processes. Three tests were constructed. The first test measured recall of information; the second test measured both recall of principles taught and their application; and the

third test required the students to draw inferences from data they had not seen before.

In Tyler's study, mentioned above, the relatively low coefficient of correlation between the test of recall of information and the test requiring application in addition to recall showed that application was a mental process different from mere recall. The correlation between recall of information in the first test and the ability to draw inferences in the third was also quite low which indicated that ability to recall information did not insure that the process of inference would occur. A comparison of the test to measure application of information and the test to measure ability to draw inference showed little relation between the two mental processes. The conclusion was that recall of information, application of information, and making inferences are three different mental processes.

Two other studies, referred to in an editorial note in Judd's 1936 book (p. 17), confirmed the findings of Tyler. Although Tyler's study did not show the hierarchy of the three mental processes, Judd reported that two later studies indicated that memorization was of a lower grade than either application or inference. Judd went on to say that inference was probably a higher mental process than application because inference was more remote from recall in Tyler's data than was application (Judd, 1936, p. 18).

At the same time that Judd was collecting data for his 1936 book, Tyler was working in the Eight Year Study (Aikin, 1942). Tyler's particular part in the study was in the area of evaluation. A report of the method for planning and

developing appraisal instruments showed a slightly more organized hierarchy of educational objectives than any that Judd presented (Smith and Tyler, 1942).

To develop useful instruments of appraisal, the committee for evaluation in the Eight Year Study had to define "effective thinking." "Clear" or "critical" thinking was used synonymously with effective thinking. The committee described three aspects of effective thinking: (1) ability to formulate reasonable generalizations from specific data, (2) ability to apply principles to new situations, and (3) ability to evaluate material purporting to be argumentative--that is, to judge the logic of the argument (Smith and Tyler, 1942, p. 36).

Smith and Tyler (1942, p. 36) noted that the three aspects of thinking overlap. The first is considered inductive and two and three are considered deductive in nature; however, the writers believed it was neither necessary nor desirable to emphasize such distinctions. They did not believe that thinking is actually separated into the three aspects when it occurs in the student. The separation was made for facilitation of evaluation (Smith and Tyler, 1942, p. 38). These three aspects of thinking appear to be similar to the classifications "comprehension," "application," and "analysis" found in the Taxonomy (Bloom, ed., 1956).

The experience of working with Judd and with the committee in the Eight Year Study led Tyler to develop some basic principles of curriculum and instruction which were published in a booklet (Tyler, 1950). In this publication, Tyler encouraged the use of what he called the problem-solving method which varies little from the scientific method of thinking. Tyler assumed that

problem-solving or thinking is a process higher than simply remembering. The steps given for problem-solving are as follows:

1. Sensing a difficulty
2. Identifying the problem more clearly by analysis
3. Collecting relevant facts
4. Formulating possible hypotheses
5. Testing the hypotheses
6. Drawing conclusions, that is, solving the problem (Tyler, 1950, p. 45)

Tyler (1950, p. 45) said that when forming hypotheses, the student would draw on generalizations or principles he already knows. Neither Judd nor Tyler was precise in listing the mental processes in the form of a hierarchy or in a taxonomy.

Publications Which Were Affected by the Development of a Taxonomy of Mental Processes

Following the publication of the Taxonomy in 1956, several books concerning higher mental processes were written. Most of them referred to the Taxonomy in some manner.

Woodruff (1961) attempted to explain to teachers how the levels of mental processes are taught. He referred to the Taxonomy as another method of presenting the same set of mental processes that he presented in his book. The mental processes important in learning and in transferring learning are said to be acquired in layers or in a definite order that cannot be violated (Woodruff, 1961, pp. 90-91). These mental processes which Woodruff (1961, p. 92) listed are presented in the following hierarchy:

Level A: Perception (sensory level)

Level B: Conceptualization

1. Differentiation
2. Integration
3. Generalization
4. Abstraction

Level C: Try Out

1. Application (for concepts)
2. Practice (for skills)

Level D: Analysis and Creation

1. Analysis
2. Synthesis
3. Evaluation and Problem-Solving

Woodruff said that the processes beginning with Level B involved or required thinking. Levels B, C, and D are only slightly different from the classifications from "comprehension" to "evaluation" in the Taxonomy.

Faculty members of the William M. Stewart School of the University of Utah described levels of learning for the purpose of helping teachers to plan activities at each of the levels (Frontiers of Thinking, 1965). Their unique schema is as follows:

Level I

Perceiving (Sensing)
Discriminating
Identifying
Retrieving (Reflecting, Remembering, Recalling)

Level II

Comparing and Contrasting
Inferring (Imagining, Explaining, Organizing, Analyzing)

Level III

Evaluating
Judging
Defining (Discovering, Hypothesizing, Abstracting, Integrating)

Level IV

Generalizing
Creating (Inventing, Synthesizing)

The order given is somewhat different from that presented in the Taxonomy or in the book by Woodruff. This lack of similarity is evidence that no hierarchy has been accepted as authoritative by educators.

Another study evolving from the Taxonomy led to the publication Classroom Questions (Sanders, 1965). The objective of this study was to give teachers a guide for varying the intellectual atmosphere in the classroom. Sanders said the basic ideas came from the Taxonomy. He preferred "memory" rather than "knowledge" as the term to describe the first level of learning. He also assigned "translation" and "interpretation" separate status because each lends itself to a distinct kind of thinking (Sanders, 1965, pp. 2-3). These terms are sub-classes under "comprehension" in the Taxonomy. Sander's categories of thinking and their definitions are as follows:

1. Memory: Recall or recognition of information
2. Translation: Change of information to symbolic form
3. Interpretation: Discovery of relationships
4. Application: Use of appropriate generalizations to solve a life-like problem
5. Analysis: Use of the method of logic to solve problems
6. Synthesis: Solving of a problem by the use of creative thinking
7. Evaluation: Judgment of good or bad according to criteria (Sanders, 1965, p. 3).

Sanders followed the idea of the members of the committee that developed the Taxonomy in that each level of thinking has as prerequisites the levels of thinking below it in the hierarchy. He also indicated that in the analysis category the student must be taught the processes of inductive and deductive thinking before any type of analysis can occur (Sanders, 1965, p. 98).

Gagné (1965, p. vi) was reluctant to state a theory about learning, but he did say that the nearest thing he would be willing to state as a theory was that "complex forms of learning require simpler forms of behavior as prerequisites."

The idea presented in Gagné's book was that there are eight kinds of learning, each requiring a different set of conditions for occurrence (Gagné, 1965, p. 19). Each set of conditions is the sum of levels of learning below the level under consideration. To reach the eighth type of learning, one must accomplish the seventh type; to reach the seventh type, one must accomplish the sixth type. This process continues to the second type at which point Gagné (1965, p. 60) was not willing to say the first type was a prerequisite. Gagné said that the existence of prior capabilities is ignored in traditional learning theories. These prior abilities considerably change the conditions necessary for further learning (Gagné, 1965, p. 21). The eight types of learning are described below:

1. Signal Learning (p. 62)
   Classical conditioning

2. Stimulus-Response Learning (p. 71)
   Operant conditioning

3. Chaining (p. 93)
   Non-verbal or simple verbal associations

4. Verbal Associations (p. 103)
   Longer verbal associations learned as meaningful phrases for use in oral speech

5. Multiple Discriminations (p. 114)
   Responding differently to different members of a category of stimuli during the process of responding to many stimuli at once

6. Concept Learning (p. 126)
   Responding to a thing or event as a class and not to each of the members of the class as in Multiple Discrimination

7. Principle Learning (p. 141)
   "Principles are chains of concepts that make up what is generally called knowledge. They represent the relationships among concepts in all the variety these relationships may take." (p. 141)

8. Problem-Solving
   Acquisition of a higher order principle as a result of using principles in the problem-solving process. Problem-solving is a type of learning because of the new principle that evolves.

Gagné said that the classification "synthesis" in the Taxonomy was the same as the learning he referred to as "higher-order principle learning or problem-solving" (Gagné, 1965, p. 262). Gagné gave the Taxonomy credit for attempting a systematic method for measuring transfer of knowledge. He said the classifications "comprehension," "application," "analysis," "synthesis," and "evaluation" are types of knowledge generalization or knowledge transfer (Gagné, 1965, p. 261).

There are two dimensions of generalization or transfer according to Gagné (1965, p. 231)--lateral and vertical. Lateral transfer is said to be the transfer of knowledge to problems of the same level of complexity. Vertical

transfer is said to be transfer of sub-ordinate principles in solving problems of a more complex nature. The "comprehension" category of the Taxonomy was said to measure lateral transfer or how broadly a student could transfer his knowledge (Gagné, 1965, p. 262). One would assume that "application" in the Taxonomy would also fit into Gagné's definition of lateral transfer. Vertical transfer occurs, said Gagné (1965, p. 262) when a student can form new higher-order principles as in the "synthesis" category of the Taxonomy.

Gagné indicated that there are two divisions of objectives for learning just as they were noted in the Taxonomy. The first division is called "specific objectives" which are used to identify what a student has or has not learned. These specific objectives are similar to the category of "knowledge" in the Taxonomy. The second division Gagné (1965, p. 263) called "general objectives"--objectives useful in assessing the student's ability to transfer knowledge. His second division is similar to the categories from "comprehension" to "evaluation" in the Taxonomy.

Few studies have been made to determine the validity of a taxonomy of educational objectives. In all of the publications reviewed, the authors suggested that research is needed to verify the fact that the levels are hierarchical. A series of studies for the purpose of exploring the construct validity of the Taxonomy was reported (Kropp and Stoker, 1966). Three questions considered were

1. Can empirical evidence be found to support or refute the imputed hierarchical structure?

2. Can empirical evidence be found to support or refute the imputed generality of the several cognitive processes?
3. Can each level of the structure be explained by more elemental cognitive aptitudes, and, if so, do the combinations or numbers of them change systematically from one level to the next?
(Kropp and Stoker, 1966, p. 164)

Four taxonomy-type tests, each in a different subject-matter area, were constructed for use with ninth-through-twelfth grade pupils. A taxonomy-type test is one in which ability to respond to questions at each successively higher level is dependent upon the ability to respond to questions in lower sub-tests. Each test consisted of six sub-tests corresponding to the major levels of the taxonomy. The first four sub-tests consisted of multiple choice items. The last two tests which were made to test the student's ability to synthesize and evaluate were made up of free response items. Approximately 1,600 students at each grade level participated (Kropp and Stoker, 1966, p. 168).

The hierarchical structure was generally supported. The placement of "evaluation" was questioned in one test. It seemed to belong before "synthesis." The faculty of the William M. Stewart School (Frontiers of Thinking, 1965) also placed "evaluation" before "synthesis."

One problem arose in the whole study. Does a student skip an item testing the higher mental processes because he cannot recall the information? The recommendation was made that the students overlearn the knowledge before being given the higher level test items (Kropp and Stoker, 1966, p. 169).

Kropp and Stoker (1966, p. 169) believed that the category known as "knowledge" should be called "recall" or "remembering" in keeping with the

other five categories which are processes exercised on content or knowledge. Sanders (1965) called the "knowledge" category "memory."

The Taxonomy of Educational Objectives was used as a pivot for this part of the review because of the clarity of structure of higher mental processes presented in the Taxonomy and because of the operational definitions given by committee of educational psychologists, each of whom is a recognized authority.

Part II: Theory of Transfer

"Transfer" was described as the influence of prior learning on the performance of a task that is different from the one used in training. The four major theories of transfer, according to Klausmeier (1961, pp. 362-363), are (1) formal discipline, (2) identical elements, (3) generalization, and (4) transposition. The last three have in common the stipulation that the new situation must be somewhat similar to the learning situation. The element of perception is involved in the theory of transposition. Klausmeier went on to say that conditions under which the original learning is acquired and the extent to which it is acquired are related to the direction and amount of transfer, regardless of which theory of transfer is under consideration.

McGeoch (1942, p. 435) would not include a discussion of the theory of transfer by formal discipline in his book because of the lack of experimental support. Judd (1908, p. 38) challenged the theory of formal discipline with his experiments from which he showed the medium of transfer to be generalization. In a later book Judd (1915, p. 392-432) wrote a whole chapter denouncing the

formal discipline theory and advancing the theory of transfer by generalization. About this time Thorndike was writing about his theory of identical elements, in which it is asserted that training in one activity influences another activity only in so far as the two have elements or aspects in common (McGeoch, 1942, p. 436). Proponents of the theory of transfer by generalization have often been opposed to the theory of transfer by identical elements. McGeoch (1942, p. 439) showed that the two theories are not contradictory in that

> generalizations are also common to both training and test situations and are, then, identical as the features subsumed under a theory of identical elements. The two theories are not mutually exclusive and readily become parts of the more general interpretation that transfer is a function of the relations between the activities from which and to which transfer occurs. Whether one calls these relations identical (similar) elements or general factors is inconsequential.

Recently other authors have supported this belief about the compatibility of theories of identical elements and generalization. It was said that in the theory of identical elements, identity may be in content, method, procedure, or aims which essentially incorporate the theory of generalization (Bigge and Hunt, 1962, p. 388; Deese, 1958, p. 219; and Soupé, 1961, p. 68).

Another indication that the various theories have much in common is Bernard's (1965, p. 60) description of the Gestalt view of transfer. He said the integral whole or functional ingredient which transfers is the combination of common elements, teaching methods, and the learner's response. This combination, he said, determines the amount and kind of transfer that occurs. He also said that transfer from old to new situations occurs when the individual recognizes the situations as being similar or when the common principles

are understood.

Theory of Transfer by Generalization

The theory of transfer by generalization is usually described as facilitation of learning of a new task when a principle or generalization is taught during the learning period. Although Judd's (1908, pp. 28-42) study of transfer by generalization is referred to as a classic, there were others who were studying transfer by generalizations about the same time. Bagley (1905, p. 313) showed that neatness learned in one subject will transfer to another subject if it is taught as a general principle and not as a specific to that subject. Coxe (1924, p. 232) and Stroud (1940, pp. 787-789) conducted experiments from which they concluded that students must be taught the processes of analyzing the similarities between old and new situations. They said that mere acquisition of the principle is not sufficient for transfer.

Application of generalizations has usually been thought of as transfer to a new situation within the same category of situations from which the generalization was derived. Gagné (1965, p. 231) described this as "lateral" transfer and showed that it is different from "vertical" transfer which is transfer from lower mental processes to higher mental processes.

McGeoch (1942, p. 396) said that generalizing is a form of transfer whether at a relatively simple level or at a complex level of abstract scientific generalization where a single statement sums up many particulars. He summarized the discussion about transfer when he said that transfer by general

factors is a law of nonspecific transfer in which "a factor, such as a principle, a method, or a set which is nonspecific to the training situation, tends to be elicited by similar situations" (McGeoch, 1942, p. 426).

Part III. Teaching Pupils to Formulate and Apply Generalizations

All methods suggested for teaching pupils to formulate and apply generalizations presented in the books and articles reviewed were quite similar, regardless of whether the book was written very recently or a half century ago. The differences over the years were concerned mainly with these issues: (1) Should the teaching sequence be inductive or deductive? (2) Should factual knowledge be taught to the mastery level before expecting the pupil to formulate generalizations? (3) Should the pupil be taught how to apply generalizations? (4) Should the process of inquiry be taught separately from subject-matter? (5) Should the pupil discover the generalization without help or should he be guided to discover it? The issues concerning formulation and application of generalizations will follow the presentation of the general teaching methods.

General Methods of Teaching

The generally accepted method for teaching a pupil to formulate a generalization is to present many examples for that generalization, help the pupil perceive the common attributes, and guide him in seeing the relation of the examples to the generalization. The method for teaching a pupil to apply a generalization is to show him how the generalization applies to a situation

different from the situations in which he learned to formulate the generalization, and to give him an opportunity to apply the generalization to another "new" situation.

Gagné (1965, p. 149) said that "instructing" means arranging the conditions of learning. His suggested instructional sequences or conditions for learning principles or generalizations were stated in this manner:

1. Inform the learner about the form of the performance to be expected when the learning is completed.
2. Question the learner in a way that requires the recall of the previously learned concepts (ideas or names).
3. Use verbal statements called "cues" that lead the learner to put the principle together in the proper order.
4. By means of a question, ask the learner to "demonstrate" one or more concrete instances of the generalization.
5. (Optional, but useful for later instruction)
   By a suitable question, require the learner to make a verbal statement of the principle (Gagné, 1965, p. 149).

In a different publication, Gagné (February 12, 1965) gave these conditions for learning principles or generalizations: (1) make sure the concepts (words) are understood first; (2) state the generalization and show how the attributes of the examples are alike or different, or have the pupil verbalize likenesses and differences; and (3) have the pupil apply the generalizations to new cases.

The following suggestion for teaching pupils for knowledge transfer was given by Judd (1915, p. 422). Pupils may be asked to analyze a large number of situations and then to state the fundamental common generalization which appears in all the different situations.

Similar suggestions for teaching pupils to formulate and apply generalizations appeared in other references (Bernard, 1965, p. 64; Klausmeier,

1961, p. 182; and McNeill, 1965, p. 10). Some authors said that the examples can be real or vicarious, but that each time a new example is added to the group, the generalization itself changes and develops into a more meaningful one (Burton, Kimball, and Wing, 1960: and Dressel, 1961).

After publication of the Taxonomy (Bloom ed., 1956), emphasis in literature changed from teaching pupils to "solve problems" as a complete operation to teaching pupils to use the cognitive processes. Very recently the emphasis on cognitive processes led to concern for teaching pupils to carry out each of a series of levels of cognitive processes as each level seemed to fit the situation. A booklet of the Department of Home Economics of the National Education Association (Teaching Processes of Thinking, 1959) was concerned with teaching pupils the processes of thinking. In this publication suggestions were given for teaching pupils to "make comparisons," "perceive relationships," "draw inferences," "reach warranted conclusions," and "apply conclusions to other situations". The difference in this approach from "problem-solving" is that illustrations were given for each of these processes of thinking in a different area of home economics. The pupil was not expected to carry out the whole process of problem-solving in every learning situation.

This trend toward teaching pupils to carry out each of the processes of thinking has led to consideration of specific guidance needed by the pupil if he is to perceive the generalization. Simpson (1965-66, p. 245) stated that pupils could be helped by asking them questions that call for similar ideas in the various situations, for cause and effect, for formulation of a generalization,

and for application to the pupil's daily life.

Deductive or Inductive Teaching Sequences

The superiority of the deductive or inductive teaching sequence has been discussed, but it is generally believed that each sequence is equally effective. Proponents of the inductive sequence claim that learning is retained for a longer period of time and transfers better when the inductive sequence is used. Hendrix (1961, p. 290) said that the "inductive" and the "discovery" method are not synonymous because a pupil can "discover" a generalization even though the teacher uses the deductive teaching sequence. This synonymous use of "inductive" and "discovery" is probably the reason for the conclusion that the inductive method is better.

The deductive sequence is one in which the teacher states the generalization before presenting examples in which the generalization is applied. The teacher proceeds to guide pupils to see the relationships among the examples after which he gives them an opportunity to apply the generalization to a new example. The inductive sequence begins with the presentation of examples after which the teacher guides the pupils to see the relationships among the examples. The pupils are then given the opportunity to verbalize the generalization and to apply it to a new situation.

Judd (1915, pp. 425-26) stated that the student who discovers a general principle or generalization arrives at his understanding in one of two ways: inductively or deductively. McNeill (1965, p. 6) believed acquisition of

knowledge is the goal whether the deductive or the inductive sequence is used. A study in which achievement test scores of 272 college students were used to measure the differential effects of the use of a deductive or inductive sequence showed that there is no difference between students taught inductively and students taught deductively (Yabroff, 1963). These findings support what Gagné and Bolles said in 1959--namely, that there was no conclusive evidence to support either method.

Factual Knowledge Necessary for Formulation of Generalizations

Knowledge transfer is said to be effective when the pupils have the prerequisite knowledge. It is most inefficient to have a class discuss something about which they have insufficient knowledge.

There were many educators in the early part of the century who fought the teaching of factual knowledge as an end in itself. Judd (1936, p. 176) said that a study of a series of closely related facts at one time is a prerequisite to broad generalization of knowledge. Gagné (1965, p. 141) and others showed that pupils cannot carry on the higher types of thinking if they do not have sufficient store of factual information. Skinner (1957, p. 413) said that insight comes to people faster and with more frequency when they have both the verbal background and much experience in insightful thinking. Taba (1963, p. 308) stated that discovery and the use of higher mental processes are good but that a great deal more has to be learned as facts.

Teaching the Process of Application of Generalizations

Application of generalizations involves a most difficult mental process and the process needs to be practiced just as the original principle has to be learned (Judd, 1915, p. 422). In all of the review concerning methods of teaching for transfer, the general attitude of the authors is that pupils must be taught how to apply generalizations and not be expected to apply these generalizations merely because they could recognize, recall, or formulate them. Another point of view was that transfer occurs more rapidly when the pupils expect it to occur (Bigge and Hunt, 1962; Hass and Wiles, 1965; and Soupé, 1961). Gagné (1965, p. 233) said that provision needs to be made for encouraging pupils to apply their knowledge as broadly and in as many new situations as can be devised if "lateral" transfer is to occur. "Vertical" transfer occurs more rapidly when pupils have considerable sub-ordinate factual knowledge and the sub-ordinate mental capabilities for transfer, such as the ability to form verbal associations, concepts, and principles (Gagné, 1965, p. 234).

A study was conducted in the field of home economics to find out whether inclusion of scientific principles in a ninth grade foods class would cause greater ability to apply principles (Shelton, 1964). The findings indicated that pupils who have teachers who teach them how to apply principles could apply these principles better than pupils who are taught only factual knowledge. There was no difference between the groups in the amount of factual knowledge learned.

Teaching the Process of Inquiry

The question remains, when one discusses the theory of transfer, as to whether it is the acquisition of generalizations with the application to new examples that transfers or the process of inquiry--that of comparing, contrasting, and thus deriving a generalization as well as relating this generalization to new situations. The issue, then, concerns which should take precedence, acquisition of the generalization or the process of inquiry.

Many authorities indicate that the process is the important part of teaching for transfer. Woodruff (1964, p. 96) and McNeill (1965, pp. 9-10) said that retention and transfer of knowledge are facilitated to the extent that pupils either learn to derive their own generalizations or in some way obtain a process of inquiry. Bruner (1961, p. 26) said that the process of inquiry has intrinsic rewards and the process itself transfers. Judd (1915, p. 422) believed that the habit of analyzing various situations and discovering productive relationships between these different particular situations should be gained by pupils if they expect to transfer knowledge. He also believed that if interest can be stimulated in discovering the common principle in a great variety of situations, the pupil will have a type of mental attitude which differs from that which he has when he contemplates a series of facts.

Suchman (1961, p. 151) used sixth-grade pupils in a study in which inquiry training was used as a method for teaching basic cognitive skills. These significant facts seemed to emerge from the study: (1) exploration, manipulation, and mastery are intrinsically motivating; (2) a reinforcing sense

of power and self-confidence comes from successful autonomous discovery; and (3) the strategy of data intake and processing has an important effect on the productivity and depth of discovery. Suchman suggested that inquiry training be a part of, and not a substitute for, courses.

Brown (1963, p. 16) said that the learning process can begin with inquiry or acquisition of factual knowledge, but that both should be in every course. Taba (1963, p. 308) thought that one of the interesting phenomena in curriculum development today is the fact that projects which purport to strengthen the role of content in learning processes have also renewed emphasis on the learning process itself.

Discovery as a Method of Learning

Discovery learning is closely allied with learning by the inductive or deductive method. A separate section on discovery is presented because of the great amount of research which has been conducted to find whether there is more transfer and retention when the pupil is encouraged to discover generalizations for himself than when he is told the generalization.

The present interest in discovery more than rivals interest in programmed instruction (Kersh and Wittrock, 1962, p. 461). Bruner is given credit for inventing the term "discovery" because of his use of the term in a report of a conference to improve the teaching of science. Johnson (1966, p. 120) showed that authors in the nineteenth century were discussing the merits of having the pupil discover principles rather than presenting the principles to

him. Johnson said that many authors indicated that discovery and the moment of insight are the same.

Bruner (1961, p. 22) said that discovery in the classroom must not be confused with Newtonian discovery, but that it is discovery by a pupil of the underlying principle involved when examining specific examples. He claimed that the more practice a pupil gets in discovery and subsequent application, the more likely he is to transfer his knowledge.

The major research on discovery of a generalization by the pupil was concerned with the amount of guidance the teacher gives in helping the pupil find the generalization. The results seemed to support the notion that some guidance is better than none but that too much guidance is detrimental to transfer.

The first experimental study reviewed on the transfer effect of discovery of principles versus giving the rule was conducted by Hendrix (1947). She found that (1) pupils who were given no rules, only examples, soon discovered the guiding principles and were able to move faster and to transfer the principle to a new situation better than either (2) a group that was taught by rule, then example, or (3) a group that discovered the principle, but had to verbalize it immediately. Her groups were small but they ranged from elementary school age through college age.

Forgus and Schwartz (1957) experimented with three different methods: (1) memorizing facts, (2) receiving the principle, and (3) discovery and verbalization of the principle. Groups two and three were superior in

three test situations--recall, simple transfer, and transfer involving problem-solving. Transfer was shown to be higher when Haslerud and Meyers (1958) gave a group of seventy-six college students the opportunity to discover principles for themselves. The control group of twenty-four college students was given specific directions.

Three studies used differing amounts of guidance in discovery to determine the procedure that would result in optimum transfer. Craig (1953) found that the hypothesis was confirmed that the amount of transfer increases as the amount of guidance in discovering basic principles increases. Two hundred college men were used to test the hypothesis. There were four amounts of guidance used. Craig also found that the transfer effect of increased guidance became somewhat greater as the difficulty of the transfer or test situation increased.

In 1956 Craig wanted to reinforce his former findings. He again conducted an experiment to find the difference in retention and transfer when the amount of directed discovery activity varied. Using two groups of fifty-three college students, he did not find conclusive evidence that there was greater transfer with one amount of guidance as contrasted with another, even after thirty-six days. Kittell (1957) found that the intermediate amount of direction proved best. He used 132 sixth-grade pupils in three groups to determine the relative effects on transfer and retention of three amounts of direction to learners.

Kirsch (1958) found that a "no help in discovering" group retained more

than either a group given some help or a group given complete directions. He carried out a subsequent study to find out why. In 1962 he experimented with three other groups of high school students, giving them each a different method of learning--(1) rote, (2) use of complete directions, and (3) guided self-discovery. He found that the self-discovery method motivated the students to practice more and thus remember and transfer more. This time Kersh used programmed booklets for the directed learning to eliminate the influence of the teacher.

Wittrock (1963) was concerned that experimentation was being carried on by several people who were using a variety of names for the stimuli--for example, guided discovery, directed learning or no help discovery--without being specific as to what they meant. He used 292 college students in groups of approximately thirty each, giving each group a different method. One method was "rule given and answer not given"; another method was "rule not given and answer given"; a third method was "rule and answer given"; and the last method was "rule and answer not given." Wittrock also noted that the outcome must be specified as to whether it is immediate retention, later retention, or transfer at a specific time for the experiment to be meaningful. He found that when the criteria are later retention and transfer, some intermediate amount of direction in discovery is best.

The foregoing studies indicated that discovery of principles results in greater positive transfer than does directed learning, where the principle is given, followed by examples. When the discovery method is used, the

experiments reported better results when some help is given in the process of discovery.

Critics of the discovery method say that there is danger that the wrong principle may be "discovered", that the transfer may be negative, and that discovery is impossible without good understanding of the facts surrounding the situations (Hendrix, 1947; Friedlander, 1966; McNeill, 1965; and Wittrock, 1963). Another criticism concerning discovery is the fact that it takes more time to help students discover and that the time and practice may be the factor in retention and not the process of discovery (Ausubel, 1963; Kersh, 1962; and McNeill, 1965).

Part IV: Preparation of Teachers

The current movement toward preparation of pupils to use higher mental processes has given impetus to the preparation of teachers for understanding and applying methods which produce this type of learning in pupils. Mayor, Henkelman, and Walbesser (1965, p. 483) said that "the decade 1955-65 has been one of curriculum innovation; the next should become one of research in learning and teaching . . . ." Gage (1964, p. 282) made a similar statement when he said that an outcome of the cognitive approach in learning has been the movement toward a theory of teaching which is "teaching as cognitive restructuring." Teachers must be prepared for shaping and manipulating pupil behaviors expected in the hierarchy of educational objectives (Gage, 1964, p. 282; and Mayor, Henkelman, and Walbesser, 1965, p. 485). Gage (1964,

p. 273) said that knowledge of the learning process does not mean that the teacher automatically knows how to teach. He went on to say that "to explain and control the teaching act requires a science and a technology of teaching in its own right." Bruner (1964, p. 307) stated that "a theory of instruction . . . is concerned . . . with improving rather than describing learning."

In the preface to his book on educational psychology, Klausmeier (1961) stated that his purpose was "to set forth a theory of classroom learning." Principles for improving efficiency of learning were included throughout Klausmeier's book. The principles for facilitating transfer were identified as emphasizing how transfer occurs and assisting the learner in the process of applying learnings. Woodruff (1961) noted in the preface of his book that there are abilities which every teacher must have to instruct pupils. Woodruff operationalized these abilities and gave concrete examples of how to teach. In the chapter on planning for teaching concepts, Woodruff (1961, pp. 115-158) presented activities in which the teacher must engage in preparation for teaching pupils to formulate and apply generalizations. Gagné (1965) called this process of teaching "preparation of the conditions for learning" or "management of instruction." He stated that transfer occurs when the teacher provides "for encouraging the learner to apply his knowledge broadly and in as great a variety of new situations as can be derived." (Gagné, 1965, p. 233). Sanders (1965, p. 7) said that teachers must reinterpret "learning by doing" to include the process of thinking even though the student may be sitting quietly at a desk. These references clearly indicate that there is a parallel process of teaching which must

accompany the process of learning.

Some experiments have indicated that there is reason for concern about teachers' knowledge of how to teach. Great differences in the achievement of like groups of students, taught by different teachers using one method, were found by Buswell in 1964 (Leton, 1966, p. 3). There was greater variation among teachers using the same method than there was between the two methods in Buswell's study. Another study showed that differences in student achievement in naval aviation were associated with differences in the instructors (Wilse and Bowers, 1957, p. 21).

Goodlad (1966, p. 37) noted that there had been over confidence in the power of the new media for teaching. He said that it had been assumed that teachers could be prepared quickly and that they could not defeat the intent of the new materials. Goodlad (1966, p. 37) stated that many of the new inductive curricular materials had been ineffective when used by teachers who taught these materials deductively.

The conclusions drawn from a set of position papers on media competences for teachers were that in order to prepare teachers for using instructional media that same type of media must be used in the methods courses (Mierhenry, 1966). This report also included operational definitions of the levels of cognitive processes to be attained by prospective teachers in the use of instructional media.

The publications concerned with teacher education show a definite trend toward identifying teacher behaviors and toward preparing prospective

teachers by using the same methods in education classes which are purported to be effective for high school teaching.

Few publications were found for helping the prospective home economics teacher become a better manipulator of pupil cognitive behaviors. For this reason, the development of the self-instructional program (Johnson, 1966) which was used in the present study for preparing teachers in home economics to teach their pupils to generalize their learnings seemed justified. A field test of this self-instructional program was the purpose of the present study.

CHAPTER III

DEVELOPMENT OF THE MATERIALS USED IN THIS STUDY

The Self-Instructional Program

The medium used to prepare teachers for teaching their pupils to formulate and apply generalizations in this study was a self-instructional program entitled "Teaching Home Economics Students to Generalize Their Learnings" (Johnson, 1966). This intrinsic program was written for the pre-service education level and was essentially self-instructional, even though it included written assignments and suggested class discussion.

Reasons for Writing the Program

The main reason for writing the program was the nationwide concern for teaching high school pupils to discover concepts or generalizations and for teaching pupils to understand generalizations to the point where they could apply them later. Another reason for the development of the program was the realization that pre-service education majors need to know an efficient method for teaching pupils to apply generalizations. Teachers must know how to teach pupils to formulate and apply generalizations, and they need specific illustrations of how to do this in their own subject-matter field. The program was written especially for teachers of home economics.

Purpose of the Program

The purpose of the self-instructional program was to prepare teachers for teaching their pupils to arrive inductively or deductively at generalizations they may then apply in all similar problems. In an effort to accomplish this, the program emphasized the following teaching generalization: a generalization is formed by pupils only through the use of many examples. Johnson used many examples in all areas of home economics, illustrating both the deductive and the inductive teaching sequences.

Understanding of the self-instructional program used in this study required the completion of two other self-instructional programs. Upon the completion of the first of these programs, Mager's Preparing Instructional Objectives (1962)--an intrinsic program--the teacher is expected to be able to state behavioral goals. At the completion of reading the second program, Johnson's "The Processes of Reasoning" (1963)--a linear program--the teacher is expected to be able to differentiate between deductive and inductive processes of reasoning and to verbalize examples of each.

Organization and Content of the Program

The program used in the present study was planned to attain the following behavioral objectives. The teacher

1. states generalizations suitable for high school teaching.
2. writes behavioral objectives which reflect specifically that generalizations were taught.

3. plans a deductive teaching sequence for formulating and applying generalizations.

4. plans an inductive teaching sequence for formulating and applying generalizations.

5. decides whether to use the deductive or the inductive sequence.

6. makes a teaching plan in which the above learning is incorporated.

A discussion of the manner for teaching the reader of the program to acquire each of these behaviors will be discussed in the text that follows.

The teaching of a generalization

The teacher is first taught what a generalization is and is not. No effort is made to guide the teacher to learn about concept formation. After finishing this first part of the program, the teacher is expected to distinguish between facts and generalizations and to restate generalizations on the level of the pupils when these generalizations previously had been stated on a higher level. Another goal of this section is that the teacher will formulate generalizations that express relationships between phenomena frequently taught as unrelated facts.

The relationship of generalizations and behavioral objectives

Assuming that the teacher had completed Mager's (1963) program, the second part of the program used in this experiment prepares the teacher to state behavioral goals in home economics and also to state generalizations which are relevant to the objectives. Application of relevant generalizations will help the pupil achieve the objective. The teacher writes behavioral

objectives and generalizations which are related.

The deductive teaching sequence

The teacher is taught to apply the deductive method of reasoning to the teaching of home economics generalizations by using the following teaching sequence:

1. State the generalization for the pupils.
2. Show examples of the generalization.
3. Lead the pupils to describe the examples.
4. Help the pupils perceive the common attributes of the examples and how these relate to the generalization.
5. Guide the pupils, through questions, to restate the generalization from observation of the relationships among the examples.
6. Give the pupils the opportunity to apply the generalization to new situations while in the classroom and to new situations outside the classroom as an assignment.

The teacher then plans a deductive teaching sequence in which the pupils learn to formulate and apply generalizations.

The inductive teaching sequence

In the inductive sequence, Johnson's program instructs the teacher to teach in the following way:

1. Start with examples instead of a statement of the generalization.
2. Help pupils describe the examples.
3. Lead the pupils to discern the common attributes of the examples and perceive the relation of these attributes to each other.

4. Guide the pupils, through questions, to state the generalizations which shows the relationships among the examples.

5. Give the pupils the opportunity to apply the generalization to a new situation while in class and to a new situation outside the classroom as an assignment.

After completion of this part of the program, the teacher is expected to be able to plan an inductive teaching sequence in which the pupil learns to formulate and apply generalizations.

The teaching sequence to use

Some generalizations, Johnson declared, need to be stated by the teachers before the examples are presented as a time-saver. Other generalizations need to be stated first, that is, taught deductively, because this is the only way those generalizations can be taught. The inductive sequence causes a great deal of interest on the part of the pupil, but it requires much time. Some generalizations need to be taught by the inductive sequence, even though it is time-consuming, because of the importance of their being learned through considerable pupil involvement. That is, the pupil needs to learn the process as well as to learn the knowledge.

The incorporation of teaching for generalizations in a teaching plan

This particular section of Johnson's program shows how both the inductive and deductive sequences are selected and incorporated in a teaching outline for a unit in family economics. The teacher is prepared to state the generalizations to be taught in a unit, to select the appropriate teaching

sequence--deductive or inductive, to incorporate both sequences consecutively for the learning of related generalizations, and to apply these generalizations in new situations. The teacher is also taught that every minute of a lesson is not spent in teaching pupils about generalizations. Johnson implied that some time must be spent in other levels of learning, such as facts and concept learning at the lower levels, and analyses and evaluation at the upper levels.

Discussion of These Methods for Teaching for Generalizations

There is a great deal of similarity in the deductive and the inductive teaching sequences as presented in the program. Both of them incorporate (1) showing many examples, (2) assisting pupils to describe examples, (3) helping pupils discern the common attributes of the examples, (4) guiding the pupils, through questions, to perceive the relationships among the attributes, and (5) arriving at a statement of the generalizations in the words of the pupils. Another similarity is (6) the application of the generalization to a new situation inside the classroom and to a new situation outside the classroom. The difference comes in the fact that, in the inductive sequence, the teacher does not state the generalization before the pupils have had a chance to see the examples.

The help given the pupils for perceiving relationships among the examples can be varied in both sequences. When a pupil sees the relationship with little guidance and visibly shows, and possibly states, the generalization, the pupil is said to have "discovered" the generalization. Johnson notes that

all pupils may not "discover" the generalization alone even in the inductive sequence. She stated that in the deductive sequence the pupil may "discover" the generalization or relationships in the sense that there is insight at the moment the pupil first understands the relationships among the examples.

Revision of the Program

Since one of the features of a self-instructional program is that it is revised after several individual student try-outs, this program was revised after nine try-outs. Newnam (1967) administered the program to individual students on the pre-service level in a test-revision cycle for the purpose of including students in the empirical development of the program. Newnam then developed a test to accompany the program and analyzed the test for reliability, using 156 college students in home economics education at the University of North Carolina at Greensboro and at four colleges out of the state.

A grant was received from the Research Council of the University of North Carolina at Greensboro to continue the testing and revision of the program. Johnson gave the program to a total of fifteen students in home economics methods classes at the University of North Carolina at Greensboro and at the Agricultural and Technical College of North Carolina in the fall of 1966. Responses of students to the assignments in the program and their comments were assembled and reviewed by this researcher as a basis for further revision of the program.

The program was intended originally for use in a college methods course in which the instructor would provide some of the answers to assignments

during class discussions. When the program was used in the field experiment, a set of answers for the assignments was compiled by this researcher to accompany the program, making it completely self-instructional. Also, comments made by the teachers in the pilot study (see Chapter IV) were used for the revision.

The Generalizations for the Foods Unit

A list of generalizations for preparation of vegetables, quick breads, and starch sauces and puddings was developed by the researcher for use by the teachers in this present experiment (see Appendix A). This list of generalizations was developed as a means of controlling the number of generalizations taught and the level of each generalization taught. The generalizations were also specified to give validity to the criterion measures. The generalizations were developed to fit the definition of a generalization given in Chapter I.

Several state curriculum guides and high school textbooks were consulted to determine the depth of teaching which is customary at the ninth grade level. The problem was also discussed with several home economics teachers who taught at the ninth grade level. Three instructors of foods and nutrition of the School of Home Economics at the University of North Carolina at Greensboro worked with the researcher in appraising each generalization for accuracy. Since all three instructors had taught at the high school level, they were considered competent to judge the generalizations for reading level and appropriateness of depth for the ninth grade pupils.

The generalizations about the preparation of vegetables were concerned

with the preservation of nutrients, color, flavor, and texture. The generalizations about quick breads covered the basis for classification of breads as quick breads, the leavening agents used, and the effect of ingredients and procedures for mixing the ingredients on the texture and appearance of the product. Generalizations about starches and puddings were limited to two starches--flour and cornstarch. The generalizations dealt with a comparison of the thickening powers of these two starches and methods to prevent lumping of the starch granules when used in the preparation of sauces and puddings.

The Criterion Instruments

The evaluation devices given the pupils were paper and pencil tests (see Appendix B) in which it was assumed that the pupil could answer the items correctly by applying the specific generalizations which had been provided and used by the teachers in this study. One of these tests was given immediately after the part of the unit in foods, prescribed in the experimental design, was completed. An equivalent form was used as a retention test three weeks after the first test was given. Both tests were developed by the researcher.

Test Items for Application

Items for testing a pupil's ability to apply generalizations are on a higher level than those which test for recall of knowledge. In the test item requiring application of a generalization, the problem situation must be new to the pupil. The problem must not disclose which generalization is necessary for the solution. When the pupil has to identify which generalization the

problem requires and goes on to apply that generalization in answering the test item, the pupil is said to have applied the generalization because "he would, not merely could, apply it" (Bloom, ed., 1956; Sanders, 1965).

The test item must present a situation that is one of a large category for which the generalization applies. Since it was impossible to know exactly which examples the teachers would use in class, a great variety of situations and foods were used in the test items in an effort to present new situations to the pupils. Three or four test items for each generalization given to the teachers were included in each test.

Development of the Preliminary Form of the Instruments

Following the procedure of Chadderdon (1947), the researcher sent open-end questions to 117 pupils in the first year of home economics in the fall of 1966 to obtain possible alternatives for the multiple choice answers which would be stated in words of the pupils. When the items were developed for the preliminary form of the test, some of the pupil responses and some phrases composed by the researcher were used as alternative phrases from which an answer was to be selected. The multiple choice test items were developed according to the rules presented by Wood (1961) in which short alternatives that are parallel in structure were emphasized.

First form

The first form of the test was given to 104 ninth grade pupils who were in the pilot study (see Chapter IV) for the purposes of securing (1) a coefficient

of reliability and (2) a measure for item analysis. This form of the test had thirty-eight multiple choice items, half of which required the pupil to apply generalizations and half of which required the pupil to recognize the correct generalizations. A coefficient of reliability greater than .63 was obtained by the use of Kuder-Richardson Formula 21. By inspection, the items were deemed to be too long and to give too much of the generalization in the situation. The alternatives were too long because they included too many possibilities in each alternative. These items were expanded into a larger number of multiple choice items with short answer phrases which expressed only one idea.

Second form

The second form of the test had 132 items. It was given to the same 104 pupils who were in the pilot study. Since only eighty-two items were completed by the 104 pupils, these were the items used in estimating reliability of the test. The Kuder-Richardson Formula 21 was again used for computing the coefficient of reliability which was greater than .79. Items were analyzed for their discriminatory power. The papers were ranked and the upper and lower 27 per cent of the test papers were used to compute a correlation coefficient (Flannagan, 1962). Those items for which the coefficient was less than .20 were revised considerably. Those items for which there was a correlation coefficient greater than .20 were revised if, by inspection of the percentage of pupils passing the item, the items appeared to have too high or too low level of difficulty.

Third form

Another revision was completed and the third form was given to ninety-six ninth-grade home economics pupils who were not in the pilot study, but who had completed the foods unit. The coefficient of reliability, computed by the Kuder-Richardson Formula 21, was greater than .69--a drop from the reliability of the second form. It was determined that the test was not valid for these particular pupils since their teachers were not told in advance that the test would be on vegetables, quick breads, and starch sauces and puddings. The decision was made to make minor revision on the third form and give it to the original 104 pupils who had been in the pilot study.

Fourth and final form

The fourth form was essentially the same as the third form. This form of the test had ninety-six items. After the test was given to the 104 pupils who had been in the pilot study, the coefficient of reliability, computed by the Kuder-Richardson Formula 20, was greater than .91. With only minor changes, this version was used as the criterion measure for this researcher. Minor changes consisted of rewording some items for greater ease in reading.

Description of the Final Instruments

There were ninety-five multiple choice items in the final version of the test in the present study (see Appendix B). Seventy-three items tested the pupil's ability to apply generalizations. The other twenty-two items tested the pupil's ability to recognize the correct generalization. Correct answers were

randomized.

Retention test

The retention test (see Appendix B) was developed by changing the situations in the first test and by substituting a similar food for each food in the test. The situations were changed only slightly and the foods substituted remained within the same category as the corresponding food in the first test. The order of the items was changed from that used in the first test. In both of the tests items referring to each of the three food categories were grouped together. In both tests the alternative which was the correct answer was randomly placed, the correct answer usually being in a different answer position in each of the tests. The tests were equivalent in the number of items made for each generalization.

Scoring key

The scoring key was developed from the answers given to the test items by the three instructors of foods and nutrition in the School of Home Economics at the University of North Carolina in Greensboro. Each instructor answered the test at a different time. The only items used in the final form of the test were those for which the three instructors had corresponding answers.

CHAPTER IV

EXPERIMENTAL PROCEDURES

This field experiment was planned to appraise a particular self-instructional program and the method it presented to teachers for guiding their pupils to formulate and apply generalizations. The effectiveness of the program and the method it taught was measured by the extent to which pupils could correctly write answers to test items in an application of generalizations test.

Design of the Experiment

The present research involved the use of a two-factor design to appraise differences (1) between teachers who had been given the program and teachers who had not been given the program and (2) among teachers with varying levels of experience in the extent to which their pupils could apply certain specified generalizations. The interaction between method of teacher preparation and teaching experience was also part of the plan. Table 1 summarizes the design of the experiment.

The major factor, method of teacher preparation, was made up of the following treatment groups: Group I, six teachers who received the self-instructional program and a list of generalizations; Group II, six teachers who received no program, but who did receive a list of generalizations; and Group III,

six teachers who received neither the program nor the generalizations.

TABLE I

DESIGN FOR A TWO-FACTOR EXPERIMENT ON TEACHER PREPARATION AND YEARS OF EXPERIENCE

Level of Teaching Experience	Teacher Preparation			
	I Program General.	II No Program General.	III No Program No General.	Total
1 - 4 years	2 teachers	2 teachers	2 teachers	6
5 - 9 years	2 "	2 "	2 "	6
10 or more years	2 "	2 "	2 "	6
Total	6	6	6	18

The second factor, amount of teaching experience, had three levels: one to four years, five to nine years, and ten or more years of teaching experience. Six teachers with the same amount of teaching experience were randomly assigned to the three treatment groups labeled "teacher preparation." The design was replicated by assigning two teachers to each cell; thus, throughout the experiment two teachers were treated alike.

Development of the Design

The experiment was first designed with two rather than three groups of teachers in factor one, the treatment variable: (1) an experimental group in

which teachers were to be asked to read and respond to the self-instructional program, and (2) a control group in which teachers would not receive the program. All teachers were then to teach the same unit in foods in a first-year home economics class on the high school level.

At this point in the designing of the study, the researcher realized that the material taught by the teachers would vary too much for the development of a valid test to measure pupil learnings. A list of generalizations concerning the preparation of vegetables, quick bread, and starch sauces and puddings was developed to control this variable (see Appendix A). The generalizations were to be given to both the experimental group and to the control group. Teachers in the control group could use any method they might have already learned for teaching their pupils to apply the given generalizations.

After much consideration, a third treatment group was deemed necessary in the design to determine whether teachers do, in fact, teach their pupils to formulate and apply generalizations without special training in a method and without being given a list of generalizations. This group was formed to give more support to the hypothesized difference expected between scores of pupils taught by teachers who had completed the program and of those students taught by teachers who had not completed the program when both groups had received the list of generalizations. This third group is sometimes referred to as the control-control group or the no-treatment group.

Consideration was given to the possibility that the amount of teaching experience might be related to a teacher's ability to teach her pupils to apply

generalizations. Therefore, three levels of teaching experience were chosen arbitrarily for the divisions in each treatment group.

Controlling for Other Sources of Error

Information was gained from teachers in all three treatment groups concerning the college from which they had graduated and the courses in which they recognized that they had learned how to teach pupils to apply generalizations. All teachers were asked to cite meetings and publications in which they had received any help for teaching pupils to apply generalizations. Teachers in Groups I and II were also asked to keep a record of how they taught for generalizations during the three-week foods unit. The materials given to the teachers are included in Appendix C.

Since another source of error might be differences among the pupils, a record of each pupil's grade point average for the past two years was collected. The grades of the pupils were used as a covariate in the statistical analysis. Pupils' scores were eliminated if the pupil had been absent a third of the time the unit was being taught. The scores of pupils who had an overall grade average lower than passing for the previous two years were also eliminated. Classes which were considered abnormal were not selected for this experiment. The "abnormal" classification included special education classes for the low achievement or low ability groups, classes in which there was a preponderance of upperclassmen, or classes which the teacher refused to have tested because of a possible lack of rapport. When there was more than one eligible class or section for testing, one was randomly selected. The first year of home

economics was selected because a cross section of pupils is enrolled at this level. The first year of home economics is usually taught at the ninth grade level; it can have no pupils below the ninth grade level, but it can have pupils enrolled from the ninth through the twelfth grades.

Controls other than those concerning the teacher and the pupil involved the content and the time limit for teaching the unit. The unit selected was the foods unit because generalizations in this area are based on scientific evidence rather than value judgments. For this reason, authorities readily agree on the generalizations. A further reason for using the foods unit was the availability of a large number of examples which teachers could use--examples which clearly relate to the generalizations. The three foods selected--vegetables, quick breads, and starch sauces and puddings--were chosen because of the frequency that North Carolina teachers include these foods as part of a total meal in their foods classes.

Sampling Design

Since the subjects were the teachers who vary in many respects in relation to the outcome variable--scores by their pupils on a test--a stratified random sample was selected. Sixteen counties within a one-hundred mile radius of Greensboro were the source of the sample. All of the 140 vocational home economics teachers in these counties on a list prepared by the State Department of Public Instruction were contacted in the fall of 1966 by means of a double postal card (see Appendix D). Information requested from the teachers

concerned the number of years of teaching experience, the number of sections of home economics on the 711 level (ninth grade) they were teaching, and whether they were teaching a foods unit in the spring of 1967 on the 711 level. Thirty-two teachers who did not respond within a month were sent a second request. Twelve teachers who did not respond to the second request were contacted by telephone.

The teachers who (1) had not had at least one year of teaching experience, (2) were not teaching on the 711 level, or (3) were not teaching a foods units on the 711 level in the spring of 1967 were eliminated. The remaining teachers were stratified into three levels of teaching experience. Six teachers were drawn from each level of teaching experience as noted in the design of this experiment. Two alternates were drawn for each level at this time. A table of random numbers was used in all the sampling.

The six teachers in each of the three experience levels were then assigned at random to three treatment groups in the first factor of the design, that of method of teacher preparation. Because there were two teachers in each of the three levels of teaching experience and in each of the three treatment groups, the total number of teachers or subjects in the experiment was eighteen. Table 1 shows this distribution.

Procedure for Securing Permission

The superintendents of the city or county school systems in which the eighteen teachers were employed were contacted by letter for permission to conduct the field experiment in their school systems. These letters also

sought permission to contact the principal of the school involved (see Appendix E). Information in the letter explained the project and that the teachers who were being asked to work beyond their regular school day would be paid for this extra time. Teachers in the group who read the program were paid twenty dollars. Teachers in the group who were asked to plan for and teach specific generalizations but who did not read the program were paid eight dollars. Teachers who were in the no-treatment group received no money.

When permission was granted by the superintendents to contact the principals, the researcher sent a letter to the principals with the same explanation that was in the letter to the superintendents. Before sending their permission the principals were asked to discuss the project with the teachers.

All superintendents and all principals agreed either by letter or by telephone to allow the project to be conducted. Two teachers in the sample refused to participate. One teacher had recently resigned her job. Five teachers were unable to participate: one had mistakenly thought 711 was second year of home economics; one did not plan to include the three specified foods in the foods unit; and three had decided to teach foods earlier than indicated on the original card. These eight teachers were replaced in the sample through the use of the alternates who had been selected. When both alternates were drawn, names of teachers from the larger sample were drawn to make up the total of eight teachers being replaced.

Pilot Study

Three vocational home economics teachers who were in the geographic area in which the research was conducted were asked to participate in a pilot study in the fall of 1966. Each of them was asked to read the self-instructional program (Johnson, 1966) and to teach a three-week unit to include vegetables, quick breads, and starch sauces and puddings. They were each given a set of generalizations from which to teach. The 104 pupils in the six classes were given a test of application of generalizations immediately after the three-week unit and a retention test, a revised form of the first test, three weeks later. The design of the experiment was not changed as a result of the findings of the pilot study. The program, instructions to the teachers, level and scope of generalizations, and the criterion test were revised somewhat on the basis of the results of the pilot study.

The writer and her major adviser observed one class taught by two of the three teachers who participated in the pilot study. The teachers were teaching a lesson on preparation of protein foods. It was concluded from this observation that the program could teach teachers how to help their pupils formulate and apply generalizations.

Collection of the Data

Preliminary Visits to the Schools

Each of the six subjects in the group who received the program and the generalizations was visited by the researcher prior to the experiment. The

purpose of the visit was to explain the research, to encourage the subjects to read the program carefully, and to teach the given generalizations in the manner taught by the program. Each subject was also asked to keep a written account of her responses to the assignments in the program and to keep a record of the manner in which she taught the pupils to apply generalizations. These directions were given to the teachers in printed form (see Appendix C). The researcher did not give the teachers an overview of the method taught by the program since this advanced information might alter the value of the program as a self-instructional device.

All of the six subjects who received the generalizations but no program were also visited by the researcher prior to the experiment. They were told of the purpose of their participation in the project, but they were not informed of the participation of the group that was receiving the program. Twelve visits were made for explaining the project to teachers in the first two treatment groups. The group of teachers who were asked by letter to allow their pupils to be tested only were not visited except on the two days for the administration of the first test and the retention test.

Administration of the Criterion Tests

The researcher administered all eighteen immediate post tests and all eighteen retention tests. Thirty-six school visits were made for administering both tests. All pupils present on the day of the test administration took the tests and all the tests were scored. Scores of those pupils who had been absent

more than one-third of the time when the foods units was being taught were eliminated. Scores of those pupils who had extremely low academic averages for the past two years were also eliminated. If a pupil took only one of the tests, his score was eliminated from the analysis.

The number of days the teachers spent in teaching the unit ranged from fourteen to eighteen school days with an average of fifteen class periods. The number of days between the end of the unit and the post test ranged from one to three days. The number of days between the post test and the retention test ranged from thirteen to eighteen school days, with an average of fifteen school days for each of the three treatment groups.

CHAPTER V

ANALYSIS OF THE DATA

The purpose of this experiment was to determine the effect of the completion of a self-instructional program by in-service teachers when teaching their pupils to apply given generalizations in a three-week unit in foods. The criterion of effectiveness was a written test to measure the ability of the pupils to apply generalizations. The experiment was a two-factor design in which the major factor involved three treatment groups: (1) six teachers in Group I received a self-instructional program and a list of generalizations; (2) six teachers in Group II received a list of generalizations, but no program; and (3) six teachers in Group III received neither the list of generalizations nor the program. The second factor, teaching experience, involved three levels: (1) one to four years, (2) five to nine years, and (3) ten or more years. The experiment was replicated by assigning two teachers to each of the three experience levels in each of the three treatment groups. A total of eighteen teachers participated in the experiment.

The design of this experiment is summarized in Table 2. This table also shows the number of pupils in each of the eighteen classes. The pupils were eligible to be counted if they met the criteria of a passing grade point average for the past two years, of attendance for two-thirds of the time the unit was being taught, and of having taken both the immediate post test and the

retention test.

TABLE 2

DESIGN FOR A TWO-FACTOR EXPERIMENT ON TEACHER PREPARATION AND YEARS OF EXPERIENCE

Level of Teaching Experience	Teacher Preparation							
	I Program General.		II No Program General.		III No Program No General.		Total	
	T*	P**	T	P	T	P	T	P
1 - 4 years	1	11	1	11	1	10	6	78
	1	11	1	14	1	21		
5 - 9 years	1	16	1	16	1	12	6	84
	1	14	1	13	1	13		
10 or more years	1	19	1	14	1	12	6	80
	1	8	1	17	1	10		
Total	6	79	6	85	6	78	18	242

*T means number of teachers
**P means number of pupils

Null Hypotheses Tested

The ten null hypotheses tested in the statistical analysis of the pupils' scores on the immediate post test and on the retention test are concerned with the effect of the teacher's having or not having had the program, the effect of the teacher's having or not having had the generalizations, the effect of varying years of teaching experience, the interaction between the teacher's having or not having

had the program and the level of teaching experience, and the interaction between the teacher's having or not having had the generalizations and the level of teaching experience.

Hypothesis I

There is no difference in the scores of their pupils on the immediate post test between (1) teachers who had had the program and the generalizations and (2) teachers who have not had the program but who have had the generalizations.

Hypothesis II

There is no difference in the scores of their pupils on the retention test between (1) teachers who have had the program and the generalizations and (2) teachers who have not had the program but who have had the generalizations.

Hypothesis III

There is no difference in the scores of their pupils on the immediate post test between (1) teachers who have had the generalizations and (2) teachers who have not had the generalizations.

Hypothesis IV

There is no difference in the scores of their pupils on the retention test between (1) teachers who have had the generalizations and (2) teachers who have not had the generalizations.

Hypothesis V

There are no differences in the scores of their pupils on the immediate post test among teachers who have had (1) 1-4 years, (2) 5-9 years, and (3) 10

or more years of teaching experience.

Hypothesis VI

There are no differences in the scores of their pupils on the retention test among teachers who have had (1) 1-4 years, (2) 5-9 years, and (3) 10 or more years of teaching experience.

Hypothesis VII

There is no interaction in the scores of the pupils on the immediate post test between (1) having or not having the self-instructional program and (2) level of teaching experience.

Hypothesis VIII

There is no interaction in the scores of the pupils on the retention test between (1) having or not having the self-instructional program and (2) level of teaching experience.

Hypothesis IX

There is no interaction in the scores of the pupils on the immediate post test between (1) having or not having the generalizations and (2) level of teaching experience.

Hypothesis X

There is no interaction in the scores of the pupils on the retention test between (1) having or not having the generalizations and (2) level of teaching experience.

Analysis of Covariance

The major factor, teacher preparation, contained two degrees of freedom since there were three treatment groups. There are two parts to the treatment variable: (1) whether or not the teacher received the self-instructional program and (2) whether or not the teacher received the list of generalizations. Individual degrees of freedom were analyzed to find the effect of the program and to find the effect of the generalizations. Criteria for orthogonal comparisons were met (see Table 3). The criteria for orthogonal comparisons are that (1) a treatment can be compared with another treatment only once and (2) the row totals must be zero. Treatment Group I was compared with Treatment Group II to find the effect of the program on the pupil scores in these groups. Treatment Groups I and II were compared with Treatment Group III to find the effect of the generalizations on the pupil scores.

TABLE 3

ORTHOGONAL COMPARISONS

	I Program General.	II No Program General.	III No Program No General.	Row Totals
Program vs No Program	1	-1	0	0
Generalizations vs No Generalizations	1	1	-2	0
Column Totals	2	0	-2	0

The covariate in the analysis of covariance was the grade point average of each pupil for the previous two years in school. A program written for the IBM computer 7040 was used for the univariate analysis of covariance. This program was described in Multivariate Statistical Programs (Clyde, Cramer, and Sherin, 1966, pp. 20-28).

Criterion measures were (1) an immediate post test and (2) a test of retention given three weeks later. Both of these tests were designed to test the pupil's ability to apply generalizations. The product moment coefficient of correlation between the two tests was greater than .95.

The analysis of the data is summarized in Table 4 for the pupil scores on the immediate post test and in Table 5 for the pupil scores on the retention test. Individual degrees of freedom associated with the method of teaching presented in the program and with the list of generalizations are shown in the breakdown of the two degrees of freedom for the major factor--teacher preparation. The four degrees of freedom associated with the interaction between teacher preparation and level of experience are sub-divided into two degrees of freedom for the interaction between level of experience and having or not having the self-instructional program and into two degrees of freedom for the interaction between level of experience and having or not having the generalizations. Since this analysis is one of covariance, one degree of freedom is shown with the regression associated with the replication between classes of teachers treated alike; and one degree of freedom is shown with the regression associated with the replication within classes of teachers treated alike.

Table 4 shows a significant difference at the 0.01 level between the scores on the post test of pupils whose teachers had the generalizations and those pupils whose teachers did not have the generalizations.

TABLE 4

ANALYSIS OF COVARIANCE OF PUPIL SCORES ON THE IMMEDIATE POST TEST

Component	Degrees of Freedom		Sums of Squares	Mean Squares	F
Teacher Preparation		2			
Method by Program	1		957.66	957.66	1.06
Generalizations	1		7169.12	7169.12	7.99*
Experience Level		2	261.52	130.76	0.14
Interaction		4			
A. Method x Experience	2		830.75	415.38	0.46
B. Generalizations x Experience	2		441.23	220.62	0.24
Replication (between classes of teachers treated alike)		8			
Regression		1			
Replication (within classes of teachers treated alike)		223			
Regression		1			
Total		241			

Number of pupils 242

*Significant at the 0.01 level

Table 5 shows a significant difference at the 0.01 level between the scores on the retention test of pupils whose teachers had the generalizations and those pupils whose teachers did not have the generalizations.

TABLE 5

ANALYSIS OF COVARAINCE OF PUPIL SCORES ON THE RETENTION TEST

Component	Degrees of Freedom		Sums of Squares	Mean Squares	F
Teacher Preparation		2			
Method of Program	1		792.68	792.68	0.93
Generalizations	1		5337.95	5337.95	6.28*
Experience Level		2	102.40	51.20	0.06
Interaction		4			
A. Method x Experience	2		830.75	415.38	0.46
B. Generalizations x Experience	2		518.58	259.29	0.30
Replication (between classes of teachers treated alike)		8			
Regression		1			
Replication (within classes of teachers treated alike)		223			
Regression		1			
Total		241			

Number of pupils 242

*Significant at the 0.01 level

Effect of Having or Not Having the Generalizations

Hypotheses III and IX: Immediate Post Test

The only statistically significant differences found in this experiment were those between the scores of pupils from both criterion tests when the teacher did or did not have the generalizations. Table 6 shows the mean scores of the pupils for the immediate post test for testing Hypothesis III, whether or not the teacher had the generalizations. Table 6 also shows the mean scores of the pupils for the immediate post test for testing Hypothesis IX, the interaction between having or not having the generalizations and level of teaching experience. Null Hypothesis III is rejected since there is a significant difference at the 0.01 level between the mean scores of pupils whose teachers did or did not have the generalizations. The mean score of pupils of teachers who had the generalizations was significantly higher. There was no significant interaction between having or not having the generalizations and level of teaching experience. The mean score for the pupils whose teachers had the generalizations and had between one and four years of teaching experience was higher than the mean score for the other five groups of pupils shown in Table 6.

TABLE 6

MEAN SCORES, IMMEDIATE POST TEST: INTERACTION B

Level of Teaching Experience	Preparation of Teachers		Row Means
	I and II Generalizations	III No Generalizations	
1 - 4 years	60.9	42.6	54.8
5 - 9 years	56.2	48.7	53.7
10 or more years	53.4	46.7	51.1
Column Means	56.8*	45.9	

*Significant at the 0.01 level.

Hypotheses IV and X: Retention Test

Null hypothesis IV is rejected because there was a significant difference at the 0.01 level between the mean scores on the retention test of the pupils whose teachers did or did not have the generalizations. The mean score of the pupils was higher when the teacher did have the generalizations (see Table 7). There was no significant interaction between the mean scores on the retention test of the pupils whose teachers did or did not have the generalizations and the level of teaching experience. Hypothesis X stated that there would be no interaction. Table 7 shows the mean scores used in testing Hypotheses IV and X.

TABLE 7

MEAN SCORES, RETENTION TEST: INTERACTION B

Level of Teaching Experience	Preparation of Teachers		Row Means
	I and II Generalizations	III No Generalizations	
1 - 4 years	60.9	42.9	54.9
5 - 9 years	57.5	52.2	55.7
10 or more years	55.4	50.1	53.6
Column Means	57.9*	48.4	

*Significant at the 0.01 level.

Effect of Having or Not Having the Program

Hypotheses I and VII: Immediate Post Test

The results of the analysis of covariance for testing Hypothesis I, whether or not the teacher had the program, and for testing Hypothesis VII, the interaction between having or not having the program and the level of teaching experience are shown in Table 8. None of the differences shown in this table were statistically significant.

The mean score on the post test of the pupils whose teachers had the program were, however, higher than the mean scores of the pupils whose teachers did not have the program--the means being 59.1 and 54.7, respectively. There was no significant interaction between having or not having the program and the level of teaching experience. The mean score of pupils whose teachers

had the program and had between one and four years of teaching experience was higher than the mean of any of the other five groups of pupils (65.5). The difference between the scores of this group of pupils and the scores of any other group of pupils was greater than the difference between the scores of any other two groups shown in Table 8. Mean scores of pupils of teachers with the least amount of teaching experience were higher than mean scores of pupils of teachers having five or more years of teaching experience.

TABLE 8

MEAN SCORES, IMMEDIATE POST TEST: INTERACTION A

Level of Teaching Experience	Preparation of Teachers		
	I Program Generalizations	II No Program Generalizations	Row Means
1 - 4 years	65.5	56.2	60.9
5 - 9 years	56.9	55.9	56.2
10 or more years	54.9	51.8	53.4
Column Means	59.1	54.7	

Hypotheses II and VIII: Retention Test

The findings for the analysis of the retention test scores showed a similar lack of significance of difference for the comparison between scores of pupils whose teachers did not have the program. Table 9 shows the mean

scores for the retention test for Hypothesis II, whether or not the teacher had the program, and Hypothesis VIII, the interaction between having or not having the program and the level of experience. No significant interaction was found. The mean score of the pupils whose teachers had the program and had between one and four years of teaching experience was again higher than that of the other five groups of pupils shown in Table 9.

TABLE 9

MEAN SCORES, RETENTION TEST: INTERACTION A

Level of Teaching Experience	Preparation of Teachers		
	I Program Generalizations	II No Program Generalizations	Row Means
1 - 4 years	62.9	58.9	60.9
5 - 9 years	57.9	56.9	57.5
10 or more years	58.0	52.8	55.4
Column Means	59.6	56.2	

When means of the post test and retention test are compared (see Tables 8 and 9), the pupils in the group whose teachers had the program and had between one and four years of teaching experience scored slightly lower on the retention test. The scores of the pupils in the other five groups show a slight increase for the retention test. The mean score for all the pupils whose teachers

had the program was only slightly higher for the retention test (59.6) than for the immediate post test (59.1). The mean score for all the pupils whose teachers did not have the program was also slightly higher for the retention test (56.2) than for the post test (54.6) taken immediately after the three-weeks unit was taught.

Effect of Levels of Teaching Experience

Hypothesis V: Immediate Post Test

The findings shown in Table 10 indicate there are no differences among the three levels of teaching experience in the mean scores of pupils on the immediate post test. The mean score for the pupils of the group of teachers having one to four years of teaching experience (54.9) is higher than the scores for the other two groups (53.7 and 51.1). The mean score for the pupils of teachers in the five to nine years of teaching experience is higher than scores of pupils in the group of teachers with ten or more years of experience.

Table 10 also shows the mean scores for the three treatment groups. These three mean scores were not compared statistically since orthogonal comparisons were made to find the effects of only a part of each treatment--program versus no program, and generalizations versus no generalizations--rather than one treatment as a whole. The mean score on the immediate post test for the pupils whose teachers had both program and the generalizations was higher than the mean scores in the other two treatment groups. The scores were higher from Group I to Group III in all levels of teaching experience.

The difference in the scores in each treatment group was higher in the one to four years of teaching experience than it was for the treatment groups in the other two levels of teaching experience.

TABLE 10

MEAN SCORES, IMMEDIATE POST TESTS: LEVELS OF EXPERIENCE

Level of Teaching Experience	Preparation of Teachers			
	I Program General.	II No Program General.	III No Program No General.	Row Means
1 - 4 years	65.5	56.2	42.6	54.9
5 - 9 years	56.9	55.9	48.7	53.7
10 or more years	54.9	51.8	46.7	51.1
Column Means	59.1	54.7	45.9	

Hypothesis VI: Retention Test

Table 11 shows the mean scores which were used in the testing of Hypothesis VI, the difference among levels of teaching experience on the retention test. There were no significant differences. The direction of the mean scores is from the high of Group I to the low of Group III on all experience levels. The direction of the mean scores is from the high in experience level one to four years to a low in the ten or more years in treatment Groups I and II. A change in the direction of mean scores occurred when pupils whose teachers had no

treatment and had from five to nine years of teaching experience had a mean score higher than scores of pupils in either of the other two experience levels. The comparison of the mean scores in Tables 10 and 11 shows that the overall means for the three treatment groups were higher on the retention test.

TABLE 11

MEAN SCORES, RETENTION TEST: LEVELS OF EXPERIENCE

Level of Teaching Experience	Preparation of Teachers			
	I Program General.	II No Program General.	III No Program No General.	Row Means
1 - 4 years	62.9	58.7	42.9	54.9
5 - 9 years	57.9	56.9	52.2	55.7
10 or more years	58.0	52.8	50.1	53.6
Column Means	59.6	56.2	48.4	

Variation Between Teachers Treated Alike

The experiment was replicated by randomly assigning two teachers with the same level of teaching experience to each of the three treatment groups. Theoretically, the two teachers in each group are the same when random assignment is used. Homogeniety of groups is a prerequisite for statistical analysis. The comparison of the mean scores of pupils of the two teachers within each group showed a wider variation than did the comparison of the mean

scores of pupils of teachers who were in different treatment groups. The mean scores and the standard deviations on the immediate post test of pupils whose teachers had the program and the generalizations are shown in Table 12. The mean scores and standard deviations on the immediate post test and the retention test for all treatment groups are shown in the tables in Appendix F.

TABLE 12

DISTRIBUTION OF SCORES OF PUPILS TAUGHT BY EACH TEACHER: GROUP I, PROGRAM AND GENERALIZATIONS, IMMEDIATE POST TEST

Level of Teaching Experience	Pupils	Means	Standard Deviation
1 - 4 years			
Teacher 1	11	71.9	10.5
Teacher 2	11	59.1	10.3
Teachers 1 and 2	22	65.5	
5 - 9 years			
Teacher 1	16	50.0	7.4
Teacher 2	14	63.7	12.8
Teachers 1 and 2	30	56.9	
10 or more years			
Teacher 1	19	52.2	15.3
Teacher 2	8	57.6	10.1
Teachers 1 and 2	27	54.9	
Total	79	59.1	

Distribution of Individual Pupil Scores

There were ninety-five items on each of the two criterion tests. The range of grades for the immediate post test was from 22 to 88. The mean score for the pupils in treatment Group I, program and generalizations was 59.1; the mean score for pupils in treatment Group II, generalizations but no program was 54.7. This distribution of grades in treatment Groups I and II is shown in Figure 1. The range and distribution of scores on the retention test are very similar.

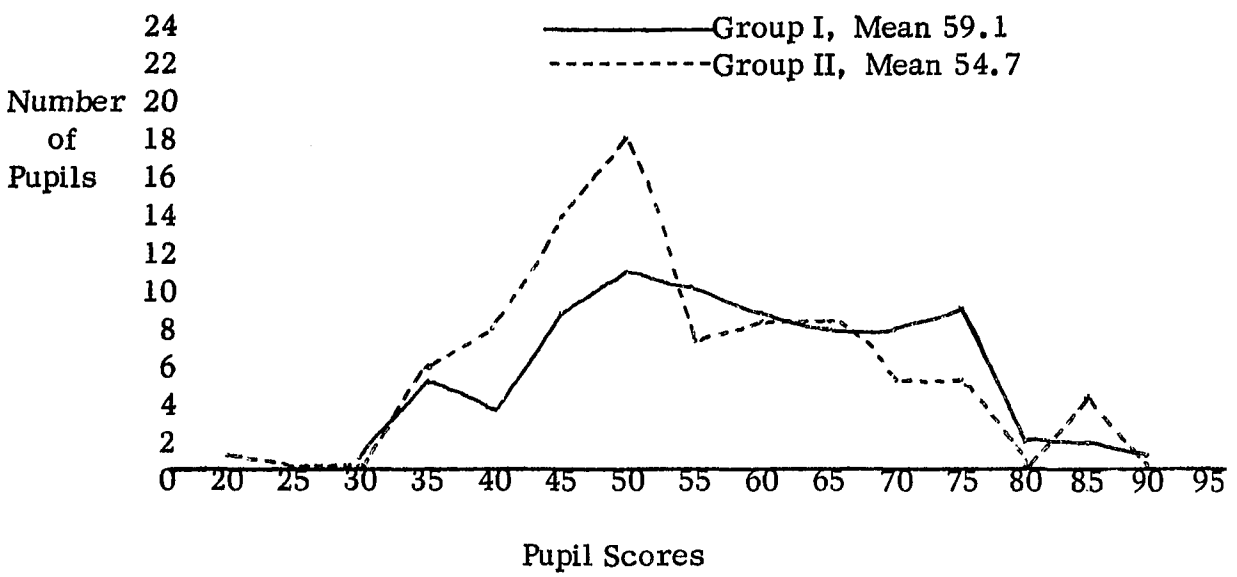

Figure 1

Comparison of Mean Scores for Group I and Group II for the Immediate Post Test

Discussion of the Results

Generalizations Versus No Generalizations

Differences between the test scores of pupils of teachers who had been given the generalizations and the test scores of pupils of teachers who had not been given the generalizations were hypothesized but were of lesser interest than hypothesized differences between teachers who did or did not have the program. The significance and direction of these differences were not surprising since teachers who were not given the generalizations undoubtedly taught an entirely different body of facts and generalizations than did teachers who were given specific generalizations to teach.

The extent to which those teachers who did not receive a list of generalizations taught subject matter content concerning vegetables, quick breads and starch sauces and puddings is not known. Teachers in the experimental schools were asked to teach their classes generalizations about these foods in depth, even though the teachers may not have given as much prominence to these foods in previous years. For this reason, it would be most unusual if scores of pupils of teachers who had not been given the generalizations were equivalent to the scores of pupils whose teachers had been given such generalizations. Obviously, pupils cannot answer test items correctly when they have not been taught the subject-matter covered in the test. It seems reasonable to assume that if teachers not given the generalizations taught entirely different kinds of material than did teachers who were given the generalizations, the

pupils of the teachers not given the generalizations could only guess at the answers.

Program Versus No Program

Differences between scores of pupils of teachers who had been given the program and scores of pupils of teachers who had not been given the program were not significant at the 0.05 level. Differences for the immediate post test would be significant at the probability level 0.16, indicating that if the null hypothesis were rejected, there would be a sixteen-in-one-hundred probability of rejecting the hypothesis when it was true.

Mean scores of pupils whose teachers had completed the program and had been given the generalizations were, however, higher than mean scores of pupils whose teachers were given the generalizations but not the program. The direction of the means was in favor of the teachers who had the program.

There was wide variation between replicates within cells, teachers receiving the same treatment being very different with respect to scores obtained by their pupils on the application of generalizations test. The mean of the nine differences between pairs of like teachers was greater than differences among the means of the three treatment groups or among the three levels of experience.

Large variability among teachers as seen in the test scores of their pupils is consistent with findings of other studies in which pupil scores was the criterion variable. This large variability results in a large experimental

error and consequent difficulty in securing significant results, even when differences among group means are large (Leton, 1966; and Wilse and Bowers, 1957).

Varying Levels of Teaching Experience

No significant differences were found among the mean scores on both tests of pupils whose teachers had varying levels of teaching experience. The direction of the means favored the pupils of teachers who had from one to four years of teaching experience. There were no significant interactions between whether or not the teacher had the program and the level of teaching experience, and between whether or not the teacher had the generalizations and the level of teaching experience.

The greatest differences among means of pairs of teachers were in pupils' scores when their teachers had taught from one to four years within all treatment groups of the first factor--teacher preparation (see Table 12 and Appendix F). The self-instructional program appeared to help this young group more than any other level of teaching experience. The generalizations were also more helpful to this group than to any of the other levels of teaching experience. The pupils in the classes of teachers who had the program and had taught less than four years obtained the highest mean score of all nine mean scores.

Mean Scores on the Criterion Tests

There was very little difference in the mean scores of pupils on the two criterion tests. All mean scores were higher on the retention test than on the immediate post test except for the mean scores of the pupils whose teachers had the program and the generalizations and had taught from one to four years.

The criterion measures were paper and pencil tests to determine the ability of pupils to apply generalizations. There is considerable question as to whether paper and pencil tests really measure a pupil's ability to carry on the higher mental processes. Written tests present an artificial situation and tend to test a pupil's ability to read as well as his ability to apply generalizations. The use of the covariate, grade point average, to predict a pupil's score does take care of variations among pupils to some extent. The use of a covariate is an adjustment of the data so that scores are comparable to what they would be if all pupils had the same grade point average. This is a statistical control to remove the effect of differing scholastic ability of pupils.

Education, Experience and Lesson Plans

No relation was found between the college from which any teacher graduated and the scores of their pupils on the tests. The number of courses, meetings, or publications from which teachers stated they had heard about teaching for generalizations seemed to have no importance to the outcome of the experiment. When a teacher stated that she had attempted to teach for generalizations before this experiment, it was expected that the experience

would affect her pupils' scores, but this experience did not appear by inspection to have any relation to pupil scores.

When the lesson plans of the teachers who had the program were reviewed, it was found that the deductive method of teaching was used more than the inductive method and that many examples were used in the teaching. The group of teachers who did not have the program also presented the material in a deductive sequence although they did not know to call it deductive. The group of teachers who received only the generalizations did use many examples in their teaching. The no-treatment group seemed to teach more by the use of one example than did the other groups.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this experiment was to appraise a self-instructional program (Johnson, 1966) for preparing in-service teachers to teach their pupils to apply given generalizations. The criterion of effectiveness was the test scores of pupils on a test which was prepared and assumed to measure the pupils' ability to apply generalizations. One test was given to the pupils immediately following the teaching of a three-week foods unit which included vegetables, quick breads, and starch sauces and puddings. An equivalent form of the immediate post test was given three weeks later to evaluate the amount of retention. Both tests were developed and tested for reliability with ninth-grade pupils who were from the same geographic area as the pupils in the experiment. The coefficient of reliability for the immediate post test was greater than .91. The product moment coefficient of correlation between the immediate post test and the retention test was .95.

The eighteen subjects were teachers who were randomly selected from the entire population of vocational home economics teachers in sixteen counties surrounding Greensboro, North Carolina. A total of 242 pupils in the eighteen classes participated in the experiment. The experiment was a two-factor design in which each factor involved three parts making a three-by-three table with nine cells. The major factor had three treatment groups: I, teachers

given a self-instructional program (Johnson, 1966) and a list of generalizations; II, teachers given the generalizations, but not the self-instructional program; and III, teachers given neither the program nor the generalizations. The second factor, teaching experience, involved three levels: (1) one to four years, (2) five to nine years, and (3) ten or more years. For replication, two teachers were randomly assigned to each of the three treatment groups within each of the three levels of teaching experience.

A pilot study simulating Group I was carried out in the same geographic area as was the experiment. The teachers in the pilot study were a part of the population of teachers from which the sample was drawn for the experiment. Two of the three teachers in the pilot study had from one to four years of teaching experience, and the other teacher had over ten years of teaching experience. There were six classes with a total of 104 pupils in the pilot study.

Each of the eighteen teachers in the experiment was asked to teach a three-week unit on foods after which the researcher administered the criterion tests. The entire experiment was completed during the school year 1966-67.

Analysis of covariance was used for data analysis, the covariate being grade point average of pupils for the previous two years in school. Two orthogonal comparisons were made: the first to determine the effect of the program when teachers were also given the generalizations and the second to determine the effect of the generalizations. Differences were analyzed (1) between mean scores of pupils whose teachers did or did not have the program when all teachers had the generalizations--treatment Group I versus Group II;

(2) between mean scores of pupils whose teachers did or did not have the generalizations--treatment Groups I and II versus Group III; and (3) among mean scores of pupils whose teachers had each of the three levels of teaching experience. Interactions were also analyzed between (1) having or not having the program and level of teaching experience and (2) having or not having the generalizations and level of teaching experience.

Findings

There was a significant difference at the 0.01 level between the mean scores of pupils of teachers who had or did not have the generalizations. The direction of the difference favored the teachers who had the generalizations.

No significant difference was found between mean scores of pupils of teachers who did or did not have the program when all teachers had the generalizations. There was a sixteen-in-one-hundred probability that the null hypothesis would be rejected when it was true, however. The direction of the mean scores was in favor of the teachers who had the program.

The differences among the three levels of teaching experience were not significant. The direction of the means favored the group of teachers who had taught from one to four years.

There was no significant interaction between mean scores of pupils of teachers who did or did not have the program and the level of teaching experience. Also, there was no significant interaction between mean scores of pupils of teachers who did or did not have the generalizations and the level of

teaching experience. However, there was great variability in the mean scores of pupils of teachers treated alike in the nine cells. A greater difference among the six teachers within the same treatment group rather than among the three treatment groups shows that the variability among teachers was a contributing factor to the results of the experiment.

Conclusions

The following conclusions were drawn:

1. There is no evidence that the self-instructional program (Johnson, 1966) helps teachers to teach generalizations to the point that scores of pupils on a test of application of generalizations are higher than the scores of pupils whose teachers did not have the program. Whether any method of preparing teachers to teach pupils to apply generalizations would carry over to the point that it is reflected in pupil scores on a written test is not known.
2. Teachers who are given a list of generalizations can teach their pupils so that the pupils will score higher on a test of application of generalizations than can pupils of teachers who have not been given the generalizations. Teachers who are not given a list of generalizations may teach a different part of the subject matter than was designated by the given generalizations from which the test was prepared.
3. Teachers with varying levels of teaching experience do not differ

with respect to their ability to teach their pupils to apply generalizations on a paper and pencil test. When academic ability of pupils is controlled, wide differences still exist among mean test scores of pupils taught by different teachers within any one treatment group.

Recommendation for Further Studies

A revision of the self-instructional program is recommended before it is used again with either pre-service or in-service teachers. The recommendation is made that the no-treatment group be omitted from any subsequent experiment. The following three studies are recommended:

1. Using in-service teachers of vocational home economics as subjects, give one group of teachers the revised program and a list of generalizations and give another group of teachers only the list of generalizations. Instead of a written test of application of generalizations, employ the following criteria of effectiveness of the self-instructional program: (1) written lesson plans of the teacher, (2) observation of teaching a short unit, and (3) a performance test of pupils' ability to apply generalizations. These outcome variables would all have specific criteria for which to judge the effectiveness of the treatment.
2. To evaluate the effectiveness of the revised self-instructional program, use the program in a workshop setting to prepare

teachers to teach their pupils to apply generalizations. Use as criteria of effectiveness the same three variables suggested in the first recommendation: (1) written lesson plans of the teacher, (2) observation of a short teaching unit, and (3) a performance test of pupils' ability to apply generalizations. The measurable aspects of the outcome variables would be analyzed to find the differences between the experimental group of teachers and a group of teachers who had neither read the program nor participated in the workshop. Both groups of teachers would include in their teaching specified generalizations in some area of home economics.

3. An experiment using pre-service home economics teachers as the subjects could be conducted by randomly assigning students to two methods classes prior to student teaching. In one of the methods classes, the students would read and discuss the self-instructional program. The students in the other methods class would be taught the same information that is included in the self-instructional program, but they would be taught in the traditional manner. The measure of effectiveness of the self-instructional program would be multivariate in that the same three criterion variables suggested in the first two recommendations for further study listed above would be used. The subjects would use a specified list of generalizations during their student teaching. The major problem in this experiment would be in controlling the variables in the student teaching centers.

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APPENDIXES

APPENDIX A

Generalizations

GENERALIZATIONS

A. Vegetables (fresh, frozen, or canned)

1. Nutrients are preserved by the decrease of (a) quantity of cooking liquid, (b) amount of cut-surface, (c) length of cooking time, and (d) length of time exposed to the air.

   a. Since some nutrients dissolve in water, they are more likely to be eaten if the cooking liquid is small and is served.

   b. Nutrients are preserved by cooking vegetables whole, with the skin intact, or in large pieces because the soluble nutrients go into the water from cut surfaces.

   c. Nutrients are preserved when the cooking time is kept to a minimum by starting the vegetables in boiling water, by keeping the lid on, and by using moderately high heat because long cooking destroys some nutrients.

   d. Nutrients are preserved by keeping the lid on during the entire cooking time to reduce the exposure to the air since some nutrients are destroyed by contact with the air.

   e. Nutrients may have to be sacrificed to some degree to preserve color or to reduce strong flavor.

   f. All vegetables are cooked by the methods that save nutrients with the exception of (a) leaving the lid off the first few minutes to keep the green color in vegetables, and (b) leaving the lid off the entire cooking time and the use of a larger amount of water (to cover) when cooking vegetables classified as strong-flavored to reduce the strong flavor.

2. Firmness or shape retention is obtained when vegetables are cooked using the methods of nutrient retention because overcooking softens the cellulose too much.

3. The pleasant flavor of mild vegetables is preserved when the methods of of nutrient saving are used in cooking vegetables because flavors can be (a) diluted in too much water or (b) changed during overcooking.

4. Vegetables classified as strong-flavored develop less strong flavors when they are cooked in (a) large amounts of water, (b) with the lid off, and (c) for a short time in order that the strong flavors be diluted, that they be allowed to escape, and that they not be allowed to get stronger from overcooking. Note that these vegetables are cooked to preserve nutrients by using large pieces and by cooking a short time on moderately high heat.

5. Green vegetables are prevented from changing to olive green (a) by leaving the cover off during the first few minutes to allow the volitale acids to escape, and (b) by cooking a short time so that the water soluble acids will not be in contact with the green color long enough to change the color.

6. Yellow vegetables are cooked by the methods for saving nutrients since yellow color is not changed during cooking. Strong-flavored yellow vegetables are cooked by the methods suggested for all strong-flavored vegetables.

7. White vegetables retain color when cooked only a short time because the chemical reaction causing grayness occurs because of overcooking.

8. In an effort to be economical when buying vegetables, determine the grade or form to select by the finished product to be made.

9. The cost of a vegetable is determined by the cost of each ounce of edible portion and not by the market unit.

****

For the purpose of agreement in classifying vegetables, the following list is provided:

Mild	Strong
Green peas	Turnip greens
Green beans	Turnips
Green limas	Collards
Field peas	Rutabagas
Potatoes (white)	Cabbage
Potatoes (sweet)	Onions
Asparagus	Cauliflower
Spinach	Broccoli
Okra	Brussels sprouts
Corn	
Squash	

B. Quick Breads

1. A bread is classified as "quick" when the leavening agent allows the bread to be baked immediately after mixing.

   a. Quick breads are leavened with baking powder or soda and an acid. (Leavening agents of steam and air are not to be used in this project). These leavening agents act immediately upon the addition of the liquid.

   b. Double-acting baking powder acts both upon the addition of a liquid and in the presence of heat.

   c. Self-rising flour is a combination of plain flour, baking powder, and salt. Self-rising flour may be substituted in any quick bread recipe for plain flour, baking powder, and salt.

2. Quick breads are characteristically tender because of the under-development of the gluten in the flour.

   a. When the batter is stirred very little after the liquid is added to the flour, the gluten in the flour is not developed which results in a more tender product and one which is free from tunnels.

   b. The more fat and sugar in proportion to the flour, the less gluten development which results in a more tender product.

C. Starch Sauces and Puddings

1. Different starches have differing thickening powers.

   Twice as much flour as cornstarch is required to thicken the same amount of liquid.

2. Certain proportions of starch to <u>any liquid</u> will make the desired consistency.

Consistency	Any liquid	Amount	Starch	Amount
Thin	" "	1 cup	Flour	1 tablespoon
	" "	" "	Cornstarch	1/2 tablespoon
Medium	" "	" "	Flour	2 tablespoons
	" "	" "	Cornstarch	1 tablespoon
Thick	" "	" "	Flour	3 tablespoons
	" "	" "	Cornstarch	1 1/2 tablespoons

3. Sauces, gravies, or puddings made from starch are kept smooth when steps are taken to separate the starch granules before adding a large amount of liquid.

   a. Lumping is prevented when the starch granules are separated by blending the starch with melted fat before adding the liquid.

   b. A smooth sauce can be made when the starch granules are separated by adding a small amount of cold liquid to make a thin paste before adding the rest of the liquid.

   c. Blending starch with sugar separates the starch granules and prevents lumping.

4. Starch thickens liquid or becomes gelatinized at a lower temperature and in a shorter time than it takes the starch to cook. ("Cook" here means to get rid of the raw taste of the flour or cornstarch). This requires that the sauce be cooked a while longer after it has thickened.

APPENDIX B

Criterion Instruments

Immediate Post Test: "Good Food Doesn't Just Happen"

Retention Test: "Foods Taste Better This Way"

GOOD FOOD

DOESN'T JUST HAPPEN

Directions: Select one answer from the group of answers in each test item. On the answer sheet, place an X beside the letter of your choice.

Sample test item

A quarter is the sum of

1. a. 2 dimes.
   b. 2 dimes and 1 nickel.
   c. 4 nickels.

Sample answer sheet

1. a. ____
   b. X
   c. ____

Ruth is planning to serve boiled, buttered okra. If she were only interested in saving nutrients, she would cook the okra

1. a. in a large amount of water.
   b. in a small amount of water.

2. a. in an uncovered pan.
   b. with the pan tightly covered.

3. a. until quite soft.
   b. only until tender.

If Ruth cooks the okra only to preserve nutrients, she will find that

4. the color
   a. turns to olive green.
   b. remains bright green.

5. the flavor
   a. remains mild.
   b. becomes strong.

Millie cooked some green limas which became olive green during cooking. This color change probably happened because she cooked them

6. a. in too much water.
   b. too long.
   c. at too high heat.

The color of limas changes because

7. a. acids are in contact with the color.
   b. the color is weakened by the water.
   c. acids can not stand high temperatures.

Barbara is planning to cook whole boiled onions to serve with a beef roast. She should cook the onions

8. a. in a small amount of water.
   b. in a large amount of water.

9. a. with the lid on.
   b. with the lid off.

When Barbara cooks onions this way

10. a. they will turn gray.
    b. nutrients will be preserved.
    c. the flavor will be mild rather than strong.

Evelyn is planning to serve canned green peas for dinner. Her family will get more nutrients if she will

11. a. boil the peas and liquid until the liquid has boiled away.
    b. heat the peas and make a sauce of the liquid.
    c. cook the liquid down before adding the peas.

This method saves nutrients because

12. a. nutrients are in the liquid of canned peas.
    b. nutrients are richer when the liquid is cooked down.
    c. peas and liquid cooked separately keep the nutrients from dissolving in the liquid.

Alice keeps cabbage wedges in the wedge shape by cooking them

13. a. below the boiling point.
    b. a long time.
    c. a short time.

This keeps the wedges firm because the cellulose is

14. a. jelled.
    b. strengthened.
    c. not softened too much.

Patsy will serve a more nutritious potato dish if she cooks the potatoes

15. a. by starting them in boiling water.
    b. by starting them in cold water.

16. a. at a boiling temperature.
    b. slowly.

17. a. with the lid off.
    b. with the lid on.

Nutrients are saved by cooking in this manner because

18. a. the nutrients can get thoroughly cooked.
    b. more of the nutrients can get into the water.
    c. the method reduces the cooking time.

When a casserole of asparagus, green peas, and cream of chicken soup is to be made, the type of asparagus to buy is

19. a. whole frozen spears at 42¢ a package.
    b. whole canned spears at 35¢ for a # 2 can.
    c. canned cut pieces at 29¢ for a # 2 can.

When selecting the type of vegetable to purchase for the product, a rule is to buy

20. a. the least expensive which is suitable for the purpose.
    b. canned when possible.
    c. fresh when possible.

Priscilla's turnips are always white when she serves them. She cooks them

21. a. a short time.
    b. in a small amount of water.
    c. a long time.

The reaction that turns turnips gray happens when

22. a. the cooking period is long.
    b. the temperature is high.
    c. too much water is used.

Jim's specialty in food is tossed salad. The method Jim should use to save nutrients is to cut the lettuce, tomatoes, and cucumbers

23. a. in large pieces and soak in ice water overnight.
    b. in small pices and soak in ice water until crisp.
    c. in large pieces just before serving.

This method preserves nutrients because

24. a. nutrients do not have time to escape.
    b. nutrients do not escape in ice water.
    c. there is more cut surface.

After Mary bought fresh green peas, she compared them with frozen and canned green peas. The least expensive listed here is

25. a. canned peas at 30¢ for 15 ounces (these have 5 oz. liquid).
    b. fresh peas at 35¢ for 20 ounces (these have 10 oz. shells).
    c. frozen peas at 33¢ for 10 ounces (no waste).

The cost of peas is measured by comparing the

26. a. quantity of food you purchase.
    b. cost per ounce at the time of purchase.
    c. cost per ounce of the vegetable to be eaten.

Sharon was comparing the cost of different brands of frozen turnip greens. If she wanted to buy the least expensive, she would buy a

27. a. 10-ounce carton for 22¢.
    b. 16-ounce carton for 30¢.
    c. 12-ounce carton for 25¢.

The reason that this carton is the best "buy" is that

28. a. the cost per ounce is less.
    b. the package is smaller.
    c. the cost of the package is less.

If Margaret is planning to make a quick bread for lunch, she will <u>not</u> make

29. a. rolls.
    b. biscuits.
    c. cornbread.

Quick breads are called "quick" because they may be

30. a. made quickly.
    b. beaten fast.
    c. baked immediately after mixing.

Penny stirs pancake batter a short time. She does this to keep them from having

31. a. uneven edges.
    b. brown spots.
    c. tunnels.

Overstirring causes

32. a. gluten in the flour to be developed.
    b. air to be incorporated in the eggs.
    c. gluten in the milk to be developed.

Quick breads are more tender when there is in the recipe a large proportion of

33. a. sugar and flour.
    b. milk and sugar.
    c. sugar and butter.

These two ingredients increase tenderness because they cause the batter

34. a. to be thinner.
    b. to have less gluten development.
    c. to be lighter.

Marty has to let the pancake batter stand because each member of the family eats breakfast at a different time. Marty's pancakes should be leavened with

35. a. soda and an acid.
    b. double-acting baking powder.
    c. single-acting baking powder.

By using this leavening agent, she will have the pancakes that

36. a. rise when cooked.
    b. double in size.
    c. rise immediately.

Betty was ready to make gravy for the fried chicken. Since she had cornstarch but no flour, she should have used

37. a. the same amount of cornstarch as flour.
    b. twice as much cornstarch as flour.
    c. half as much cornstarch as flour.

Betty uses this amount of cornstarch because

38. a. flour has more thickening power than cornstarch.
    b. cornstarch and flour have the same thickening power.
    c. cornstarch has more thickening power than flour.

Susan wants to make a cheese sauce from the liquid of canned asparagus. The flour used to thicken the sauce is

39. a. mixed with melted fat before adding the liquid.
    b. added to all of the cold liquid just before cooking.
    c. added to the hot liquid.

This method makes a smooth sauce because

40. a. starch granules become gelatinized.
    b. flour must be added to cold liquid.
    c. starch granules need to be separated.

Yvonne is making cherry pie from canned cherries. To thicken the one cup of cherry juice to a medium thickness, Yvonne uses

41. a. one tablespoon flour or one tablespoon cornstarch.
    b. two tablespoons flour or one tablespoon cornstarch.
    c. two tablespoons flour or one and one-half tablespoons cornstarch.

The amount you selected is correct because

42. a. cornstarch has less thickening power than flour.
    b. flour and cornstarch have the same thickening power.
    c. these proportions of either flour or cornstarch will make a medium thickness.

Denise cooked a chocolate pudding that was smooth and as thick as it should be, but she could taste the flour. She should have

43. a. used less flour.
    b. stirred it more.
    c. cooked it longer.

The flour taste is present because

44. a. starch needs constant stirring.
    b. starch thickens a liquid before it cooks thoroughly.
    c. too much flour was used.

Directions: The remaining test items are single and do not affect each other.

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45. Ruth cooks green beans whole, in a small amount of water, with the lid off at first, and for a short time to preserve

    a. the color and texture but it causes the nutrients to escape.
    b. the nutrients, but it allows the color to be lost.
    c. the shape, flavor, and color while preserving most of the nutrients.

46. Cauliflower when cooked in water to cover, with the lid off, becomes

    a. gray.
    b. less firm.
    c. less nutritious.
    d. strong.

47. To save nutrients, slaw is prepared

    a. one hour before serving.
    b. the night before.
    c. just before serving.

48. Frozen peas are always bright green. This shows that they were prepared for freezing by boiling 1-2 minutes with

    a. the lid off.
    b. the lid on.
    c. a small amount of water.

49. When cabbage is cooked in a small amount of water with the lid on, the nutrients are preserved and the

    a. color remains green.
    b. flavor becomes more strong.
    c. flavor becomes more mild.

50. Onions remain whole if cooked

    a. a short time.
    b. uncovered.
    c. in a large amount of water.
    d. in a small amount of water.

51. Quartered apples should be cooked for preserving nutrients

    a. a short time.
    b. with the lid off.
    c. in a large amount of water.

52. A vegetable which should be cooked with the lid off and in much water is

    a. field peas.
    b. potatoes.
    c. collards.
    d. green beans.

53. The grade or form of tomatoes to buy for a tomato and hamburger casserole is

    a. canned pieces at 23¢ for 10 ounces.
    b. canned whole at 30¢ for 10 ounces.
    c. fresh tomatoes at 32¢ for 10 ounces.

54. Cauliflower cooked a long time will be

    a. more nutritious.
    b. gray in color.
    c. mild.

55. To save nutrients, cook potatoes for potato salad

    a. whole in the skins in a small amount of water.
    b. whole in a small amount of water.
    c. diced in water to cover.

56. Irish potatoes may lose their pleasant flavor if cooked

    a. in small pieces.
    b. a long time.
    c. a short time with the lid on.

57. Sweet potatoes are boiled to save nutrients

    a. in a large amount of water.
    b. in their skins.
    c. in an uncovered pan.

58. Which is more expensive: one pound of chicken at 35¢ a pound or one pound of hamburger at 50¢ a pound? Chicken is half bone.

    a. Hamburger.
    b. Chicken.
    c. They are the same price.

59. If Tommy Lou leaves the lid off broccoli when cooking it, she can expect it to be

    a. strong because the acids escape.
    b. green because the acids escape.
    c. olive green because the acids escape.

60. Canned turnip greens are cooked after the can is sealed. This causes the turnip greens to be

    a. mild and bright green.
    b. strong and less green.
    c. mild and less green.
    d. strong and bright green.

61. Cabbage retains the shape if cooked

    a. a short time.
    b. with the lid off.
    c. in a large amount of water.
    d. in a small amount of water.

62. Collard greens are cooked like other vegetables with the exception of

    a. cooking a long time in a large amount of water.
    b. leaving the lid off and using a large amount of water.
    c. cooking a long time and leaving the lid off.

63. Canned green beans cut in pieces are preferred for a casserole

a. because the flavor is better.
b. to save money.
c. because the appearance is better.
d. because they are easier to eat.

64. Irish potatoes cooked quickly in a small amount of water will

a. be gray-white.
b. be less nutritious.
c. be too soft.
d. remain white.

65. The only problem in cooking squash is to save the nutrients because squash

a. does not become mushy.
b. does not change color easily.
c. is already strong flavored.

66. A vegetable that should be cooked slightly differently from the method of cooking recommended for saving of nutrients is

a. potatoes.
b. squash.
c. turnips.
d. corn.

67. Quick breads differ from other breads in the kinds of

a. flour used.
b. fat used.
c. leavening agent used.

68. Muffins are tender when there is little stirring after the

a. eggs are added to the milk.
b. milk is added to the flour.
c. sugar is added to the milk.
d. sugar is added to the flour.

69. Biscuits are more tender than yeast rolls because of the

a. under-development of the gluten in the biscuits.
b. More flour in the yeast rolls.
c. more time biscuits take to rise.

70. The addition of fat and sugar causes corn muffins

    a. to be able to stand a while before baking.
    b. to be more tender.
    c. to develop more gluten.
    d. to be less tender.

71. Biscuits that can be baked an hour or so later must have as one ingredient

    a. soda.
    b. sugar.
    c. double-acting baking powder.
    d. single-acting baking powder.

72. Corn muffins, pancakes, and cheese biscuits are quick breads because they all have

    a. fat.
    b. all-purpose flour.
    c. milk.
    d. baking powder.

73. Under-development of gluten causes muffins

    a. to have tunnels.
    b. to be more tender.
    c. to be lighter.

74. The recipe Sheron plans to use calls for self-rising flour. She has plain flour and she will have to use

    a. salt and sugar.
    b. salt and baking powder.
    c. baking powder and soda.

75. Which one of the following is a quick bread recipe?

a.	b.	c.
1 cup plain flour	1 cup plain flour	1 cup plain flour
1/2 t. soda	1 t. baking powder	
1/4 t. salt	1/4 t. salt	1/4 t. salt
2 T. fat	2 T. fat	2 T. fat
1/2 cup milk	1/2 cup milk	1/2 cup milk

76. When substituting self-rising flour in a biscuit recipe, the following ingredients are left out:

    a. baking powder and salt.
    b. baking powder and sugar.
    c. plain flour, baking powder and soda.
    d. plain flour, baking powder and salt.

77. If cornstarch is substituted equally for flour in a recipe for gravy, the outcome will be a gravy which is

    a. thinner.
    b. thicker.
    c. smoother.

78. Cheese sauce made from the liquid from canned asparagus is thickened by adding cornstarch to

    a. all the cold liquid.
    b. all the hot liquid.
    c. all the melted fat.

79. When using flour as a thickening agent, the liquid

    a. must be milk.
    b. may be any liquid.
    c. must be meat broth.
    d. must be a fruit juice.

80. One cup of fruit juice for a pie will be the same thickness when two tablespoons flour are used as when

    a. one tablespoon cornstarch is used.
    b. two tablespoons cornstarch are used.
    c. one-half tablespoon cornstarch is used.
    d. four tablespoons cornstarch are used.

81. Gravy is made for pork chops by adding flour to the

    a. hot fat.
    b. hot milk.
    c. cold milk.

82. When one cup of tomato juice or one cup of milk or one cup of pineapple juice is used to make a thick sauce, the amount of flour to use

    a. is greater for milk than for fruit juice.
    b. is greater for vegetable juices than for milk.
    c. remains the same for all juices.

83. A medium thick steak gravy may be made with one cup of water and either

    a. 2 T. flour or 1 T. cornstarch.
    b. 1 T. flour or 1 T. cornstarch.
    c. 2 T. flour or 2 T. cornstarch.

84. Alice made a butterscotch pudding that was the right thickness. She no doubt used

    a. 4 T. flour to each cup milk.
    b. 3 T. flour to each cup milk.
    c. 1 T. flour to each cup milk.

85. One cup of liquid for cream of tomato soup may be slightly thickened by

    a. 1 1/2 T. cornstarch.
    b. 1 T. cornstarch.
    c. 1/2 T. cornstarch.
    d. 2 T. cornstarch.

86. After gravy thickens, it should

    a. stand a while off the heat before serving.
    b. be taken up immediately.
    c. be cooked a few minutes longer.

87. The flour for thickening a fresh apple pie is mixed with the

    a. two cups sliced applies.
    b. 1/2 cup water.
    c. one cup sugar.
    d. 1/4 cup sliced butter.

88. Ann's sauce for the banana pudding was lumpy when she finished mixing it. She probably mixed the

    a. sugar with the flour.
    b. flour with all the milk.
    c. flour with a small amount of the cold milk.

89. A vanilla pudding which is removed from the heat as soon as it thickens will probably

    a. be lumpy.
    b. taste of raw flour.
    c. taste of raw eggs.

90. To make one cup of thin cherry sauce for ice cream, thicken cherry juice with

    a. 3 T. flour.
    b. 2 T. flour.
    c. 1 T. flour.

91. Carolyn made a casserole of

    1 cup cut-up chicken
    1 cup cooked rice
    1 T. pimento
    1 cup milk
    3 T. flour

    When cooked, the casserole will be

    a. too thick.
    b. too thin.
    c. too lumpy.

92. When making a lemon sauce for gingerbread, the cornstarch is blended with the

    a. lemon juice.
    b. sugar.
    c. all of the water.
    d. all of the water and juice.

93. Gravy made by adding all of the flour to the milk before adding the fat will be

    a. smooth.
    b. lumpy.
    c. white.

94. A chocolate cream pie recipe directs the person to add the flour to the

    a. milk.
    b. chocolate.
    c. eggs.
    d. sugar.

95. The corn Marty cooked was quite soupy. She thickened it by adding some flour to

    a. a small amount of cold water before adding to the corn.
    b. the corn and hot liquid in the sauce pan.
    c. a half cup of cold water before adding to the corn.

FOODS TASTE BETTER THIS WAY

Directions: Select one answer from the group of answers in each test item. On the answer sheet, place an X beside the letter of your choice.

Bett's potatoes are white when she serves them. She kept them white by cooking them

1. a. a short time.
   b. in a small amount of water.
   c. a long time.

The reaction that turns potatoes gray happens when

2. a. too much water is used.
   b. the temperature is high.
   c. the cooking period is long.

Alice cooked some green peas which became olive green during cooking. This color change probably happened because she cooked them

3. a. in too much water.
   b. at too high heat.
   c. too long.

The color of peas changes because

4. a. acids are in contact with the color.
   b. acids can not stand high temperatures.
   c. the color is weakened by the water.

Mary will serve a more nutritious corn dish if she cooks the corn

5. a. by starting it in cold water.
   b. by starting it in boiling water.

6. a. slowly.
   b. at a boiling temperature.

7. a. with the lid on.
   b. with the lid off.

Nutrients are saved by cooking in this manner because

8. a. the method reduces the cooking time.
   b. the nutrients can get thoroughly cooked.
   c. more of the nutrients can get into the water.

Barbara was comparing the cost of different brands of frozen collard greens. If she wanted to buy the least expensive, she would buy a

9. a. 12 ounce carton for 22¢.
   b. 16 ounce carton for 31¢.
   c. 10 ounce carton for 20¢.

The reason for this carton's being the best "buy" is that

10. a. the package is smaller.
    b. the cost per ounce is less.
    c. the cost of the package is less.

When a casserole of green beans and cream of chicken soup is to be made, the type of green beans is

11. a. canned cut pieces at 28¢ for a # 2 can.
    b. whole frozen beans at 35¢ a package.
    c. whole canned beans at 30¢ for a # 2 can.

When selecting the type of vegetable to purchase for the product, a rule is to buy

12. a. fresh when possible.
    b. the least expensive which is suitable for the purpose.
    c. canned when possible.

Ruth is planning to serve boiled, buttered green beans. If she were only interested in saving nutrients, she would cook the green beans

13. a. in a large amount of water.
    b. in a small amount of water.

14. a. with the pan tightly covered.
    b. in an uncovered pan.

15. a. until quite soft.
    b. only until tender.

If Ruth cooks the green beans only to preserve nutrients, she will find that

16. the color
    a. turns to olive green.
    b. remains bright green.

17. the flavor
    a. remains mild.
    b. becomes strong.

Sue keeps Brussels sprouts in the round shape by cooking them

18. a. below the boiling point.
    b. a long time.
    c. a short time.

This keeps the Brussels sprouts firm because the cellulose is

19. a. strengthened.
    b. not softened too much.
    c. jelled.

After Mary bought fresh green limas, she compared them with frozen and canned limas. The least expensive listed here is

20. a. fresh limas at 35¢ for 25 ounces (these have 15 oz. shells).
    b. frozen limas at 33¢ for 10 ounces (no waste).
    c. canned limas at 30¢ for 14 ounces (these have 4 oz. liquid).

The cost of limas is measured by comparing the

21. a. quantity of food you purchase.
    b. cost per ounce at the time of purchase.
    c. cost per ounce of the vegetable to be eaten.

Sarah is planning to cook cauliflower to serve with a ham. She should cook the cauliflower

22. a. in a small amount of water.
    b. in a large amount of water.

23. a. with the lid off.
    b. with the lid on.

If she cooks cauliflower in this manner

24. a. nutrients will be preserved.
    b. it will turn gray.
    c. the flavor will be mild rather than strong.

Dave likes to make a colorful cole slaw. The method Dave should use to save nutrients is to cut the cabbage, tomatoes, and cucumbers in small pieces

25. a. and soak in ice water until crisp.
    b. just before serving.
    c. and soak in ice water overnight.

This method preserves nutrients because

26. a. nutrients do not escape in ice water.
    b. there is more cut surface.
    c. nutrients do not have time to escape.

Patty is planning to serve canned green limas for dinner. Her family will get more nutrients if she will

27. a. cook the liquid down before adding the limas.
    b. heat the limas and make a sauce of the liquid.
    c. boil the limas and liquid until the liquid has boiled away.

This method saves nutrients because

28. a. limas and liquid cooked separately keep the nutrients from dissolving in the liquid.
    b. nutrients are richer when the liquid is cooked down.
    c. nutrients are in the liquid of canned limas.

Sharon has to let waffle batter stand because each member of the family eats breakfast at a different time. Sharon's waffles should be leavened with

29. a. double-acting baking powder.
    b. soda and an acid.
    c. single-acting baking powder.

By using this leavening agent, the waffles will

30. a. rise immediately.
    b. rise when cooked.
    c. double in size.

Margaret stirs muffin batter a short time. She does this to keep them from having

31. a. uneven tops.
    b. tunnels.
    c. brown spots.

Overstirring causes

32. a. gluten in the flour to be developed.
    b. gluten in the milk to be developed.
    c. air to be incorporated in the eggs.

Sally is planning to make a quick bread for lunch. She will not make

33. a. muffins.
    b. biscuits.
    c. rolls.

Quick breads are called "quick" because they may be

34. a. beaten fast.
    b. made quickly.
    c. baked immediately after mixing.

Blueberry muffins are more tender when there is in the recipe a large proportion of

35. a. sugar and butter.
    b. sugar and flour.
    c. milk and sugar.

These two ingredients increase tenderness because they cause the batter

36. a. to be thinner.
    b. to have less gluten development.
    c. to be lighter.

Marion is making peach pie from canned peaches. To thicken the one cup of peach juice to a medium thickness, Marian uses

37. a. two tablespoons flour or one tablespoon cornstarch.
    b. one tablespoon flour or one tablespoon cornstarch.
    c. two tablespoons flour or one and one-half tablespoons cornstarch.

The amount you selected is correct because

38. a. these proportions of either flour or cornstarch will make a medium thickness.
    b. flour and cornstarch have the same thickening power.
    c. cornstarch has less thickening power than flour.

Mary Lou cooked a coconut pudding that was smooth and as thick as it should be, but she could taste the flour. She should have

39. a. cooked it longer.
    b. stirred it more.
    c. used less flour.

The flour taste is present because

40. a. too much flour was used.
    b. starch thickens a liquid before it cooks thoroughly.
    c. starch needs constant stirring.

Patsy wants to make a cheese sauce from the liquid of canned green beans. The flour used to thicken the sauce is

41. a. mixed with melted fat before adding the liquid.
    b. added to the hot liquid.
    c. added to all of the cold liquid just before cooking.

This method makes a smooth sauce because

42. a. starch granules become gelatinized.
    b. starch granules need to be separated.
    c. flour must be added to cold liquid.

Betsy was ready to make tomato sauce for pork chops. Since she had cornstarch but no flour, she should have used

43. a. half as much cornstarch as flour.
    b. twice as much cornstarch as flour.
    c. the same amount of cornstarch as flour.

Betsy uses this amount of cornstarch because

44. a. cornstarch has more thickening power than flour.
    b. cornstarch and flour have the same thickening power.
    c. flour has more thickening power than cornstarch.

Directions: Select one answer from the group of answers.

45. A vegetable that should be cooked slightly differently from the method of of cooking recommended for saving nutrients is

    a. carrots.
    b. cauliflower.
    c. sweet potatoes.
    d. corn.

46. When onions are cooked in a small amount of water with the lid on, the nutrients are preserved and the

    a. color turns gray.
    b. flavor becomes more strong.
    c. flavor becomes more mild.

47. Squash are cooked to save nutrients by boiling them

    a. whole.
    b. in an uncovered pan.
    c. in a large amount of water.

48. To save nutrients, cook sweet potatoes

    a. diced in water to cover.
    b. whole in the skins in a small amount of water.
    c. whole in a small amount of water.

49. The grade or form of asparagus to buy for a casserole is

    a. canned pieces at 23¢ for 10 ounces.
    b. fresh asparagus at 32¢ for 10 ounces.
    c. canned whole spears at 30¢ for 10 ounces.

50. Turnips when cooked in water to cover, with the lid off, become

    a. gray.
    b. less firm.
    c. strong.
    d. less nutritious.

51. Carrots may lose their pleasant flavor if cooked

    a. a short time with the lid on.
    b. in small pieces.
    c. a long time.

52. Ann cooks okra whole, in a small amount of water, with the lid off at first, and for a short time to preserve

    a. the color and texture but this process causes the nutrients to escape.
    b. the shape, flavor and color while preserving most of the nutrients.
    c. the nutrients, but this process allows the color to be lost.

53. Canned tomatoes cut in pieces are preferred for a casserole

    a. because the flavor is better.
    b. to save money.
    c. because the appearance is better.
    d. because they are easier to eat.

54. Canned asparagus is cooked after the can is sealed which causes the asparagus to be

    a. bright green.
    b. less green.

55. The only problem in cooking carrots is to save the nutrients because carrots

    a. are already strong.
    b. do not change color easily.
    c. do not become mushy.

56. Which is more expensive: one pound of chuck steak at 75¢ a pound or one pound of boneless round steak at 95¢ a pound? Chuck steak is one-third bone.

    a. They are the same price.
    b. Chuck steak.
    c. Boneless round steak.

57. Frozen limas are always bright green, a fact which shows that they were prepared for freezing by boiling 1-2 minutes with

    a. the lid off.
    b. a small amount of water.
    c. the lid on.

58. Broccoli remains firm if cooked

    a. in a large amount of water.
    b. in a small amount of water.
    c. a short time.
    d. uncovered.

59. To save nutrients, prepare tossed salad

    a. one hour before serving.
    b. the night before.
    c. just before serving.

60. Corn cooked quickly in a small amount of water will

    a. be too soft.
    b. be more nutritious.
    c. lose its color.

61. Quartered pears should be cooked for preserving nutrients

    a. a short time.
    b. with the lid off.
    c. in a large amount of water.

62. Donna leaves the lid off cabbage when cooking it; therefore she can expect it to be

    a. green because the acids escape.
    b. olive green because the acids escape.
    c. strong because the acids escape.

63. Turnips cooked a long time will be

    a. gray in color
    b. more nutritious.
    c. mild.

64. Turnip greens are cooked like other vegetables with the exception of

    a. cooking a long time in a large amount of water.
    b. cooking a long time and leaving the lid off.
    c. leaving the lid off and using a large amount of water.

65. A vegetable which should be cooked with the lid off and in much water is

    a. blackeyed peas.
    b. corn.
    c. turnip greens.
    d. okra.

66. Onions retain their shape if cooked

    a. with the lid off.
    b. in a large amount of water.
    c. a short time.
    d. in a small amount of water.

67. The recipe Lynne plans to use calls for self-rising flour. She has plain flour and she will have to use

    a. baking powder and soda.
    b. salt and baking powder.
    c. salt and sugar.

68. Pancakes that can be baked an hour or so later must have as one ingredient

    a. single-acting baking powder.
    b. double-acting baking powder.
    c. sugar.
    d. soda.

69. When substituting self-rising flour in a muffin recipe, leave out the following ingredients

    a. baking powder and salt.
    b. baking powder and sugar.
    c. plain flour, baking powder and soda.
    d. plain flour, baking powder and salt.

70. Under-development of gluten causes pancakes

a. to have tunnels.
b. to be lighter.
c. to be more tender.

71. Which one of the following recipes is not a quick bread?

a. 1 cup plain flour
1/4 t. salt
2 T. fat
1/2 cup milk

b. 1 cup self-rising flour
2 T. fat
1/2 cup milk

c. 1 cup plain flour
1/2 t. soda
1/4 t. salt
2 T. fat
1/2 cup sour milk

72. Quick breads differ from other breads in the kinds of

a. flour used.
b. leavening agent used.
c. liquid used.

73. The addition of fat and sugar causes muffins

a. to develop more gluten.
b. to be more tender.
c. to be able to stand a while before baking.
d. to be less tender.

74. Muffins are more tender than yeast rolls because of the

a. under-development of the gluten in the muffins.
b. more flour in the yeast rolls.
c. more time muffins take to rise.

75. Muffins, waffles, and biscuits are quick breads because they all have

a. all-purpose flour.
b. milk.
c. fat.
d. baking powder

76. Waffles are tender when there is little stirring after the

a. eggs are added to the milk.
b. milk is added to the flour.
c. sugar is added to the milk.
d. sugar is added to the flour.

77. Green peas that Debbie cooked were quite soupy. She thickened them by adding some flour to

    a. a half cup of cold water before adding to the green peas.
    b. a small amount of cold water before adding to the green peas.
    c. the green peas and hot liquid in the pan.

78. One cup of vegetable liquid for a sauce will be thickened the same when two tablespoons flour are used as when

    a. two tablespoons cornstarch are used.
    b. one tablespoon cornstarch is used.
    c. four tablespoons cornstarch are used.
    d. one-half tablespoon cornstarch is used.

79. When one cup V-8 juice or one cup of broth or one cup of peach juice is used to make a thin sauce, the amount of flour to use

    a. remains the same for all juices.
    b. is greater for broth.
    c. is greater for vegetable juices than for broth.

80. If cornstarch is substituted equally for flour in a recipe for vanilla pudding, the outcome will be a pudding which is

    a. smoother.
    b. thinner.
    c. thicker.

81. Ann's sauce for the pineapple pudding was lumpy when she finished mixing it. She probably mixed the

    a. sugar with the flour.
    b. flour with all the milk.
    c. flour with a small amount of the cold milk.

82. To make one cup of thin tomato sauce to serve on meatballs, thicken the tomato juice with

    a. 1 T. flour.
    b. 2 T. flour.
    c. 3 T. flour.

83. One cup of liquid for cream of vegetable soup may be slightly thickened by

a. 1/2 T. cornstarch
b. 2 T. cornstarch.
c. 1 T. cornstarch.
d. 1 1/2 T. cornstarch.

84. Cheese sauce made by adding all of the flour to the milk before adding the fat will be

a. lumpy.
b. white.
c. smooth.

85. Gravy is made for fried chicken by adding flour to the

a. hot fat.
b. hot milk.
c. cold milk.

86. The cornstarch for thickening fresh peach pie is mixed with the

a. one cup of sugar.
b. 1/2 cup of water.
c. 1/4 cup sliced butter.
d. two cups sliced peaches.

87. Coconut cream pie recipes direct the person to add the flour to the

a. milk.
b. coconut.
c. sugar.
d. eggs.

88. Carolyn made a casserole of

1 cup of tuna
1 cup of cooked macaroni
1 T. pimento
1 cup milk
3 T. flour

When cooked, the casserole will be

a. too thin.
b. too thick.
c. too lumpy.

89. A medium thick pork chop gravy may be made with one cup of water and either

a. 1 T. flour or 1 T. cornstarch.
b. 2 T. flour or 2 T. cornstarch.
c. 2 T. flour or 1 T. cornstarch.

90. After sauces thicken, they should

a. be taken up immediately.
b. stand a while off the heat before serving.
c. be cooked a few minutes longer.

91. When making an orange sauce for cake squares, blend the cornstarch with

a. the orange juice.
b. all the water.
c. the sugar.

92. A butterscotch pudding which is removed from the heat as soon as it thickens will probably

a. taste of raw eggs.
b. taste of raw flour.
c. be lumpy.

93. Alice made a chocolate pudding that was the right thickness. She no doubt used

a. 4 T. flour to each cup milk.
b. 1 T. flour to each cup milk.
c. 3 T. flour to each cup milk.

94. With cornstarch as a thickening agent, the liquid

a. must be a fruit juice.
b. must be milk.
c. may be any liquid.

95. Cream sauce made from the liquid from canned green peas is thickened by adding cornstarch to

a. all the hot liquid.
b. all the melted fat.
c. all the cold liquid.

APPENDIX C

Materials Given to Teachers

Group I

Instructions (11 items)
Record of Education and Experience
Information About Pupils
How Did You Teach for Generalizations? (5 columns)

Group II

Instructions (8 items)
Record of Education and Experience
Information About Pupils
How Did You Teach for Generalizations? (2 columns)

Group III

Record of Education and Experience
Information About Pupils

INSTRUCTIONS

1. Read the program at short intervals of time. Quit when you are tired.

2. Do not browse; read and think about every paragraph. You may find that you have to read more slowly than you usually do.

3. Answer, on the sheets provided, the assignments on the pages where you are requested to "write your name on a sheet of paper and turn in the assignment." These answers will be collected on the date of the first test.

4. Keep a record of the way in which you taught for generalizations using the sheets provided. You may use these blanks as a guide for planning. These sheets will be collected on the date of the retention test.

5. Complete the blank concerning the information about experience and education and turn it in on the day of the first test.

6. Fill in the information concerning the pupils any time before the day of the retention test, at which time the papers will be collected.

7. Turn in the program on the day of the first test.

8. You will receive the twenty-dollar check on the day of the retention test.

9. Plan lessons to include the generalizations about vegetables, quick breads, and starch sauces and puddings after you have read the program.

10. Limit your teaching to 15 days (three or more weeks).

11. Teach on the 711 level.

RECORD OF EDUCATION AND EXPERIENCE

Name _____

School _____

Educational Record

College	Degree	Year Graduated

1. How many courses have you taken since you earned the B.S. degree? _____

   How many of these courses were graduate courses? _____

   How many of these courses were for certification credit only? _____

2. How many courses have you taken since you earned the M.S. degree? _____

3. What courses have you taken since 1960 in which the method of teaching pupils to formulate and apply generalizations was a part of the course?

Name of the Course	College	Describe the Method

4. Indicate other places, such as vocational conference, county group meetings, or non-credit workshops, in which you have come in contact with how to teach pupils to formulate and apply generalizations.

Meeting	Describe the Method

5. Indicate the reading you have done in which the method for teaching the pupils to formulate and apply generalizations was described.

Publication	Describe the Method

Experience Record

1. What experience have you had other than teaching?

Description of Job	No. of Years

2. What teaching experience have you had?

Subject and Grade Taught	No. of Years

3. How have you taught pupils to formulate and apply generalizations in the past?

INFORMATION ABOUT PUPILS

Name of Teacher _____

School _____

Name of Students	Days Absent	Grade Point Average for Two Years

HOW DID YOU TEACH FOR GENERALIZATIONS?

Generalization	Deductive or Inductive	Examples Used	Learning Experiences	Evaluation of How Well Pupils Learned

INSTRUCTIONS

1. Plan lessons to include the generalizations about vegetables, quick breads, and starch sauces and puddings.

2. Limit your teaching to 15 days (three or more weeks).

3. Teach on the 711 level.

4. Keep a record of the way you taught for generalizations on the sheets provided. These will be collected on the day of the retention test.

5. Complete the blank concerning the information about experience and education and turn it in on the day of the first test.

6. Fill in the information concerning the pupils any time before the day of the retention test, at which time the papers will be collected.

7. The tests will be administered by the researcher.

8. The eight-dollar check will be delivered on the day of the retention test.

HOW DID YOU TEACH FOR GENERALIZATIONS

Generalization	What did you or the pupils do to learn the generalizations?

APPENDIX D

Card Sent to Teachers for
Information About
Population

Card Sent to Teachers for Information
About Population

October 5, 1966

In preparation for a research project, I need to know the number of years of teaching experience home economics teachers have had, whether they are teaching 711.1 or 711.2, and whether they will teach a foods unit in the spring of 1967.

Would you be so kind as to indicate this information along with your name and address? I will need every one of these cards returned before any work can begin. Please send the card back by return mail if you possibly can.

Return Card

How many years of teaching experience have you had? (Count every year whether you taught home economics or another subject)._____

Give the number of sections of home economics 711.1 or 711.2 that you teach._____
(If you do not teach on this level, place a 0 in the blank).

Will you be teaching a foods unit in the spring of 1967 on the 711 level?_____

Name_____

School_____

School Address_____

APPENDIX E

Letter to Superintendent

Letter to Principal

_____, Superintendent
_____ Schools
_____, North Carolina

Dear Mr. _____:

We would like to ask your permission to contact your home economics teacher, _____, and ask her to participate in a field experiment to be conducted this spring in Home Economics 711 classes in eighteen different schools. Before you give this permission, we realize that you would like to know what will be expected of a cooperating teacher. _____ will be asked to complete a self-instructional program on a new method of teaching and to teach a three-week unit in foods in which she attempts to apply what she has learned in the program. Because this cooperation would require time outside of her usual teaching duties, we would pay her twenty dollars ($20.00).

The purpose of the research study is to evaluate the method of teaching presented in the program. Pupils in one section of home economics in each school will be tested at the end of the three-week period of teaching and again three weeks later. During the three weeks of teaching, the pupils will study topics they usually cover in a foods unit so that it will in no way disrupt their planned home economics program.

A pilot study has been conducted at _____ High School and at _____ High School. If you would like to call the home economics teachers in these schools, they are in a position to tell you the effect they feel their cooperation has had on the home economics program.

_____ was randomly selected from a list of teachers from sixteen counties in this geographic area. This research is a part of Research Project No. _____ funded by the Research Council of the University of North Carolina at Greensboro. The field work is a part of Mrs. Smith's requirements for the Ph.D. degree. For the past eight years she has been an instructor in the School of Home Economics in the capacity of college supervisor of student teachers.

We would be very grateful for your participation to enter _____ High School. Please call us collect if you would rather not have this experiment conducted in your system. Upon written receipt of your approval, we will contact the principal and the home economics teacher for their agreement.

Very sincerely,

Hildegarde Johnson, Ph.D.
Chairman, Home Economics Education

(Mrs.) Rebecca M. Smith
Doctoral Fellow

_____, Principal
_____ High School
_____, North Carolina

Dear Mr. _____:

In a recent correspondence, Mr. _____, superintendent of _____ Schools, has given me permission to contact you concerning an experiment we would like to conduct in home economics in your school. _____ was randomly selected from a list of teachers from sixteen counties in this geographic area.

Before you give us your permission to visit _____ High School, I will explain what would be expected of a cooperating teacher. _____ will be asked to complete a self-instructional program on a new method of teaching and to teach a three-week unit in foods in which she attempts to apply what she has learned in the program. Because this cooperation will require time outside her usual teaching duties, we will pay her twenty dollars ($20.00).

The purpose of the research study is to evaluate the method of teaching presented in the program. Pupils in one section of Home Economics 711 in each of the eighteen schools will be tested at the end of the three-week period of teaching and again three weeks later. During the three weeks of teaching, the pupils will study topics they usually cover in a foods unit so that it will in no way disrupt their planned home economics program.

This research is a part of Research Project No. _____ funded by the Research Council of the University of North Carolina at Greensboro. The field work is a part of the requirements for the Ph.D. degree. For the past eight years I have been an instructor in the School of Home Economics in the capacity of college supervisor of student teachers.

I will be very grateful to you and _____ if you will give me permission to carry out the experiment in _____ High School. Will you discuss this letter with _____ and send your answer to me by the enclosed postal card? If your answer is in the affirmative, I will come to _____ High School to discuss the details on the day and hour you indicate.

Very sincerely,

(Mrs.) Rebecca M. Smith

APPENDIX F

Distribution of Scores of Pupils Taught
by Each Teacher

TABLE 12

DISTRIBUTION OF SCORES OF PUPILS TAUGHT BY EACH TEACHER: GROUP I, PROGRAM AND GENERALIZATIONS, IMMEDIATE POST TEST

Level of Teaching Experience	Pupils	Means	Standard Deviations
1 - 4 years			
Teacher 1	11	71.9	10.5
Teacher 2	11	59.1	10.3
Teachers 1 and 2	22	65.5	
5 - 9 years			
Teacher 1	16	50.0	7.4
Teacher 2	14	63.7	12.8
Teachers 1 and 2	30	56.9	
10 or more years			
Teacher 1	19	52.2	15.3
Teacher 2	8	57.6	10.1
Teachers 1 and 2	27	54.9	
Total	79	59.1	

TABLE 13

DISTRIBUTION OF SCORES OF PUPILS TAUGHT BY EACH TEACHER: GROUP II, GENERALIZATIONS BUT NO PROGRAM, IMMEDIATE POST TEST

Level of Teaching Experience	Pupils	Means	Standard Deviations
1 - 4 years			
Teacher 1	11	64.9	14.6
Teacher 2	14	47.6	7.6
Teachers 1 and 2	25	56.2	
5 - 9 years			
Teacher 1	16	59.2	6.9
Teacher 2	13	52.0	13.7
Teachers 1 and 2	29	55.9	
10 or more years			
Teacher 1	14	60.3	14.2
Teacher 2	17	43.4	5.9
Teachers 1 and 2	31	51.8	
Total	85	54.7	

TABLE 14

DISTRIBUTION OF SCORES OF PUPILS TAUGHT BY EACH TEACHER: GROUP III, NO PROGRAM AND NO GENERALIZATIONS, IMMEDIATE POST TEST

Level of Teaching Experience	Pupils	Mean	Standard Deviation
1 - 4 years			
Teacher 1	10	40.5	8.2
Teacher 2	21	44.7	6.9
Teachers 1 and 2	31	42.6	
5 - 9 years			
Teacher 1	12	53.2	6.1
Teacher 2	13	44.2	8.9
Teachers 1 and 2	25	48.7	
10 or more years			
Teacher 1	12	39.8	10.5
Teacher 2	10	53.3	4.7
Teachers 1 and 2	22	46.7	
Total	78	45.9	

TABLE 15

DISTRIBUTION OF SCORES OF PUPILS TAUGHT BY EACH TEACHER: GROUP I, PROGRAM AND GENERALIZATIONS, RETENTION TEST

Level of Teaching Experience	Pupils	Mean	Standard Deviation
1 - 4 years			
Teacher 1	11	67.2	14.4
Teacher 2	11	58.6	11.7
Teachers 1 and 2	22	62.9	
5 - 9 years			
Teacher 1	16	53.5	8.2
Teacher 2	14	62.4	11.1
Teachers 1 and 2	30	57.9	
10 or more years			
Teacher 1	19	58.8	16.1
Teacher 2	8	57.3	13.3
Teachers 1 and 2	27	58.0	
Total	79	59.6	

TABLE 16

DISTRIBUTION OF SCORES OF PUPILS TAUGHT BY EACH TEACHER: GROUP II, GENERALIZATIONS BUT NO PROGRAM, RETENTION TEST

Level of Teaching Experience	Pupils	Mean	Standard Deviation
1 - 4 years			
Teacher 1	11	68.6	15.6
Teacher 2	14	49.3	6.9
Teachers 1 and 2	25	58.9	
5 - 9 years			
Teacher 1	16	60.9	7.8
Teacher 2	13	53.0	9.9
Teachers 1 and 2	29	56.9	
10 or more years			
Teacher 1	14	61.5	16.4
Teacher 2	17	44.0	7.3
Teachers 1 and 2	31	52.8	
Total	85	56.2	

TABLE 17

DISTRIBUTION OF SCORES OF PUPILS TAUGHT BY EACH TEACHER: GROUP III, NO PROGRAM AND NO GENERALIZATIONS, RETENTION TEST

Level of Teaching Experience	Pupils	Mean	Standard Deviation
1 - 4 years			
Teacher 1	10	39.6	5.6
Teacher 2	21	46.2	9.4
Teachers 1 and 2	31	42.9	
5 - 9 years			
Teacher 1	12	57.5	8.7
Teacher 2	13	46.8	10.9
Teachers 1 and 2	25	52.2	
10 or more years			
Teacher 1	12	45.4	8.8
Teacher 2	10	54.6	6.2
Teachers 1 and 2	22	50.1	
Total	78	48.4	