AN EXPERIMENTAL STUDY TO COMPARE THE INDIVIDUAL LABORATORY AND MODIFIED- DEMONSTRATION METHODS FOR TEACHING FOOD PREPARATION

Thesis for the Degree of M. S.

MICHIGAN STATE COLLEGE

May S. Bay

1952

This is to certify that the

thesis entitled

An experimental study to compare the individual and modified demonstration methods for teaching food preparation.

presented by

May Stiles Bay

has been accepted towards fulfillment of the requirements for

M.S. degree in Foods and Nutrition

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Date May 23, 1952

O-169

ACKNOWLEDGMENT

The writer wishes to express her sincere appreciation to Dr. Dena Cederquist for her expert guidance and valuable assistance, and to Miss Margaret Ann Wallace who helped in the instruction, and without whose willing cooperation this study could not have been possible.

Grateful acknowledgment is also due to Dr. Pauline Paul for her help in judging the laboratory practical tests, and to Dr. William Baten and Dr. Wilma Brewer for their skilled guidance in carrying out the statistical analysis of the data.

The writer is also indebted to Miss Doris Smith, Dr. Elizabeth Osman, Mr. Lewis Mayhew, and Mr. Robert Jackson for their assistance in the construction and analysis of the final written test.

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An examination of the curricula of secondary schools, colleges, and universities suggests that there is some lack of agreement among educators concerning the subject matter taught in the various educational institutions. Furthermore, the method of teaching these subjects is, in many cases, a controversial issue and varies considerably with both teachers and the subjects taught. Progressive teachers in any field are continually trying to improve their techniques of instruction and to be alert for methods, as well as materials, through which their teaching may be more effective.

The method or methods best suited to produce maximum development of all pupils remains an open question. Most educators will agree that there is no one perfect method. Teacher preferences and personality, as well as teacher capabilities, play an influential part in determining the effectiveness of instruction. Only when sound training and knowledge are supplemented with genuine interest and enthusiasm on the part of the instructor will his teaching become a form of educational guidance through which students gain not only knowledge and skills, but personal development as well.

The use of demonstration in teaching is not new, and many instructors recognize the suitability of this technique for effecting genuine learning. In laboratory courses in home economics and other sciences, the demonstration method has been used successfully to teach particular units of work, as well as the entire content of some courses. The effectiveness of this

technique in accomplishing the basic aims of education has been studied by several investigators.

In the fall of 1950 it was decided in the department of Foods and Nutrition to use the teacher-demonstration method to instruct several classes in beginning food preparation. Delay in completing the remodeling of two foods laboratories necessitated this decision, and ultimately the work of one entire quarter, with the exception of the laboratory practical test, was taught by this method. The units of study were not changed from those usually included in the beginning classes; only the method of presentation was altered to fit the existing situation. At the end of the quarter the four teachers instructing these classes suggested that the demonstration method had shown advantages which had not been evident in previous classes. Since the program had not been carried out under controlled conditions, the findings were purely subjective. Therefore, it seemed desirable to obtain more concrete information concerning this problem and to apply experimental methods for comparing the effectiveness of the demonstration method with the method ordinarily used in this department for teaching beginning food preparation to students in home economics and hotel administration.

Several of the instructors doubted the advisability of substituting teacher-demonstration alone for the individual laboratory method. It was felt that in order to understand fully and make application of factual knowledge, a student must also acquire at least the basic manipulative skills and techniques in this particular field of study. Therefore, it was decided to modify the teacher-demonstration method to include individual laboratory experience in at least half of the scheduled periods.

The methods to be compared were defined as follows.

Individual laboratory method: units of work assigned for preliminary study; written and verbal instructions given at the beginning of each laboratory class; preparation of various food products by individuals or by pairs of students; judging products and class discussion.

Modified-demonstration method: units of work assigned for preliminary study; written and verbal instructions given in each laboratory class in addition to utilizing, as often as possible, the teacher-demonstration method for presenting the lessons, and combining this with supervised practice periods for individual experience in at least half of the scheduled periods; class discussion combined with the demonstrations and periods of judging products.

The terms "Method C" and "Method D" have been given to the individual laboratory and modified-demonstration methods respectively.

Additional instruction using the lecture method was given both groups at the same time. Review sections were also held two hours each week for all students; however attendance at the review periods was not required.

This study seemed useful from several standpoints. Primarily, it was desirable to compare the effectiveness of the two methods in terms of: (1) the understanding and application of the principles involved in the preparation and use of the foods included in the course with emphasis placed on the physical and chemical properties of these foods, and (2) the quality of products prepared during and at the end of the

instructional period with reference to development of specific skills and abilities considered important in food preparation.

Moreover, it was desirable to determine the extent to which the cost of supplies could be reduced or more effectively proportioned through the use of the modified-demonstration method. The School of Home Economics has a relatively high cost per student enrollment compared to other schools at Michigan State College. Although there are several justifiable reasons for the existing financial situation, this department has found, as have all schools, that increased budgets seldom keep up with increasing costs. It is understandable, then, that any means by which costs can be reduced without sacrificing the caliber of instruction should be considered worthwhile.

In addition to the purposes listed above, it was also hoped to develop the problem in such a way that further evaluation of these students might be made when they were enrolled in succeeding food courses. In this way it might be possible to test further the validity of the results observed in this study.

REVIEW OF THE LITERATURE

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Many studies comparing the demonstration and the laboratory methods of teaching have been done in areas other than home economics, and only a few have been carried out using college students. Nevertheless, many of the techniques employed in these investigations might easily be applied to laboratory work in home economics, and particularly to food preparation; therefore, they will be reported here. In the field of foods and nutrition only one research study comparing the two methods was available (1,2). However, several home economists have published information on this subject (3,4,5).

Various factors have contributed to the interest in this topic. Some of the earlier studies were conducted after World War I when greatly increased high school enrollments necessitated teaching large numbers of students, often in large classes. The increased cost of science instruction for these larger numbers of students was often prohibitive. In many secondary schools double laboratory periods were being reduced to single periods for uniformity in scheduling classes. In the depression years of the 1930's, school administrators again found it difficult to provide adequate facilities, equipment, and supplies from their limited budgets. During World War II the availability, as well as the cost, of equipment and materials resulted in renewed interest concerning the use of demonstration as an effective substitute for individual laboratory work. The question of the greater effectiveness of one method over the other in particular areas of study, or for accomplishing certain objectives, has been the basis of several investigations.

In 1935 Comley (1,2) studied the teaching of meal planning and service to students who had had a beginning course in food preparation. Eighth grade girls, paired by intelligence quotients and scores on a pre-test, studied the same number and types of food products. Each student in the control group prepared an example of each type; in the demonstration group the teacher prepared family size amounts of several different food products of each type. The demonstration students had no laboratory experience in this course prior to the practical examination. Evaluation was done by written tests and a practical test which consisted of planning, preparing, and serving a luncheon which met certain requirements regarding the types of foods included. Ratings were made of both products and management.

The results favored the demonstration group. Although the mean scores on the written pre-test were almost identical, the mean score of the demonstration group was significantly higher on the final written test. This group also made greater gains during the period of instruction as measured by the difference between pre-test and final test scores. In the preparation of the luncheons, the scores on the food products were almost identical for the two groups, but the demonstration group was distinctly superior in the management of their luncheons.

Comley concluded that "after girls have developed a fair amount of skill in food preparation the demonstration method may be used with as great or greater success than the laboratory method."

In 1941 Bloye and Long (3) reported results of a study made as part of a foods and nutrition curriculum planning program. Because the kind and amount of home making education varies prior to entering college,

students enrolled in food preparation classes were sectioned according to their ability and previous experience. Proficiency standards were defined for freshman students which, if met, allowed the girl to choose, for the following foods course, between instruction by the conventional laboratory method, or by the demonstration method. This latter method was similar to that which the author has termed "modified-demonstration method", because one-half of the three hour laboratory period was taught by demonstration, the other half was used for practice.

This study showed that the choice of method produced no measurable difference in the average test scores earned by either group. The high scores were equally divided between those in the demonstration group and those in the conventional group. No results were given on the distribution of low scores.

The data from this study, although extensive, having covered over 450 students enrolled in freshman and sophmore foods classes, had been discarded and were not available for more critical study.[1]

A common criticism of the use of the demonstration method is that students do not get adequate experience in manipulative skills. Shultz (4) stated that the use of the demonstration method should be followed by pupil performance, the teacher "commending what is good and correcting what is wrong." Student-demonstration in place of teacher-demonstration was used by Stackhouse (5) to insure pupil experience. Under teacher supervision each boy enrolled in a second course in food preparation

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[1]Personal communication from Amy I. Bloye, Head of Department of Foods and Nutrition, Purdue University, Lafayette, Indiana.

practiced in preliminary laboratory periods, and then demonstrated a particular type of food product. Each student had experience through his own work plus assisting another student, but since each pupil did not prepare every product there was considerable saving of money. In addition, the author stated that there was greater interest and greater learning stimulus both in preparing for and observing the demonstrations than groups taught by other methods had shown. Cooke (6) reported that a rotating system of student-demonstrations gave sufficient laboratory practice in chemistry to insure experience in manipulative techniques. He also felt that this method resulted in better attention and retention by students than teacher-demonstration seemed to produce. Boretz (7) concluded that pupil-demonstration effected better learning, as well as more efficient management of time. Popkin (8) found that, in addition to the advantages mentioned above, the student-demonstration gave valuable experience in the problems involved in the preparation and organization of lessons. Lenkford (9), on the other hand, reported that pupil-demonstrations are likely to prove less effective than those by the teacher unless the teacher supervises the student-demonstrations very closely.

One of the earlier investigations was made in 1924 by Anibal (10) teaching natural science. In many instances the results favored the lecture-demonstration group; however, the difference in information gains was not large enough to be conclusive. Cunningham (11) criticized this study for the lack of reliability of testing measures and for the limited number of students used in each group.

In 1927 Knox (12) made a study in high school chemistry. Some of his results may be summarized as follows: (1) the demonstration method was superior to the laboratory method in teaching mentally heterogeneous groups for the purpose of retention in high school chemistry; (2) the demonstration method was better suited for presentation of information for relatively permanent retention than the individual laboratory program; (3) the demonstration method was equal if not superior for the purpose of imparting scientific attitudes and training in methods of attack. However, Knox found that poorer students learned better through use of the laboratory method. This is in agreement with Anibal (10) and Horton (13), whereas Kahn (14) and Payne (15) reported that students of lower mental ability profited more by use of the demonstration method than when working individually.

Carpenter (16) and Nash (17) found no decisive differences between the two methods and concluded that students did equally well by using either technique. Goldstein (18) reported no significant difference in the learning of the subject matter covered in a high school science course, but the students taught by demonstration had much lower scores on tests determining resourcefulness.

The results of three studies in teaching high school chemistry made by Horton (13) favored the use of the laboratory method. This investigator contended that this method was superior particularly with respect to laboratory skills. Schlesinger (19) stated that, although the teacher-demonstration method is an effective technique, it disregards the superiority of the laboratory method in development of motor skills, attitudes, and interests.

Those claiming that students profit more through the use of demonstration include Kahn (14), Hunt (20), Pugh (21), and Selberg (22). The results of a study made by Chester (23) also favored demonstration, but he modified the method by using a teacher-demonstration lecture at the same time each student dissected teacher-prepared biological material. This study resulted in 50 per cent saving of student-time, although there was no saving in costs. Teaching biology under similar conditions, Stathers (24) found 10 per cent superiority in learning by the demonstration group, as well as 50-70 per cent saving of time.

In addition to economy of time, financial savings have been considered by many workers. Comley (1) reported 42 per cent less operating expense for the demonstration group in meal planning and service. Anibal (10) required only one set of equipment in teaching the demonstration group as compared with 15 sets when the students did the work, thus effecting considerable saving in equipment and laboratory furniture as well as building space. Webb (25) reported the same economy, but pointed out that effective demonstration may require larger size and often more expensive equipment. Van Horne (26) using one set of equipment for the demonstration group in chemistry, found the cost to be 4.4 per cent of that required for the individual laboratory classes. If half of the work had been done by each method, he estimated the approximate saving would have been 47.8 per cent.

It has been stated that the demonstration method has sometimes been used to serve larger numbers of students at one time. Many workers, however, feel the size of the class is an important factor to control.

Cunningham (11) and Fuller (27) have warned that the class should be small enough to insure every student a clear view of the demonstration. On the other hand Stuit and Engelhart (28) reported that the size of the class "does not appear to be any educative factor." Kahn (14) and Chester (23) limited their classes in biology to twenty students. Webb (25) favored this number of students, or the use of large size equipment which is often more expensive.

While some workers have obtained results favoring one method or the other, many of them advocate the use of both methods for better learning (11,14,16,29,30,31). Lankford (9), in summarizing this point of view, has stated that: "(1) each method offers training in certain knowledges, skills, and habits not offered by the other; (2) in the interests of economy, both time and money, it seems desirable to perform more laboratory exercises by the demonstration than by the individual method; (3) at the beginning of every laboratory course there should be a sufficient use of the demonstration method to acquaint the pupils with apparatus and with some of the accepted methods of experimentation. The pupils should be allowed to perform some exercises individually in order to acquire desirable manipulative skills and laboratory techniques and habits."

Evaluation of achievement is part of the problem involved in any study made of teaching methods. Cunningham (11) reported that later studies were uniformly superior to earlier ones both in validity and reliability of the tests and in the statistical procedures used in handling the data.

Several studies have been made on measuring achievement in food preparation classes. Amidon (32) studied management in relation to meal preparation. The results showed that, although there was a high correlation between scores on an objective-type written test and time management of the test meal, students' ability to prepare meals could not be predicted with any degree of certainty on the basis of the written test scores, or on the basis of intelligence tests. The reliability coefficient of the written tests administered in this study was only .3. (Theoretically, a perfect test would have a reliability coefficient of 1.0.) This author also emphasized the advantages of having more than one judge score each meal or food product.

Segner (33), in studying the evaluation of student achievement in seventh and ninth grade foods classes, used two objective-type written tests and three of the check list variety. Over one-hundred teachers used equivalent forms of the tests, one covering facts and principles and the other based on application of these facts and principles. Both were used as pre-tests and as final tests. The reliability coefficient of both tests together was .85.

Comley (1) constructed equivalent forms of an objective-type test, reliability .83 and .76, and also used rating scales evaluating the practice meal separately for meal planning, food products, and management. The reliability of the rating scales ranged from .77 to .81. The written tests, one used as a pre-test, the other as a final test, attempted to measure not only factual knowledge, but also application of these facts.

Hatcher (34,35) used written test scores, scores of food products, ratings of meals prepared, and dietary ratings to determine the relative effectiveness of teacher-student planned course of study as compared to the conventional teacher-planned method. Price (36), in comparing sixty minute and ninety minute class periods for the effectiveness of instruction in ninth and tenth grade foods classes, used a written objective-type pre-test and final test plus two practical tests on meal preparation.

Many investigators have criticized research studies in which outcome was measured by tests for factual information only (28,29,37,38). Horton (13) used individual performance tests for evaluating achievement in high school chemistry classes. Goldstein (18) attempted to measure resourcefulness in students taught by the two methods. Confronted with laboratory problems of varying degrees of difficulty, these students were scored on the time it took to solve each problem. Stuit and Engelhart (28) advocated repeating the final examination after a suitable period in order to test for permanent retention.

Brown (39) stressed validity, reliability, and objectivity as characteristic of good evaluation devices. Well constructed objective-type tests are more reliable than essay-type tests, but if poorly constructed they have only slight validity. She also stated that in laboratory courses written tests should be supplemented by performance tests whenever possible. However, while many writers have recognized the importance of reliability and validity of the tests used, evidence concerning these qualities is, for the most part, lacking. On the other hand, absolute evidence which would prove that the tests were not reliable is also lacking.

In conclusion, several summary articles were reviewed. The reports of Riedel (37) and Downing (40) both stressed the inconclusiveness of earlier studies. Stuit and Engelhart (28) concluded that the problem "seems yet to be unsolved and as complex as ever," and "the objectives, the preference of the teacher, the nature of the pupils, and the facilities of the school will largely determine which method should be used." Cunningham (11) recommended that both methods be used, favorable consideration being given to the demonstration method when: "(1) the learning involved is complicated and difficult; (2) the apparatus used is complicated and difficult to manipulate or expensive; (3) the apparatus used is sufficiently large to be seen at a distance; (4) the pupils are likely to make mistakes when working along; (5) a large amount of subject matter must be covered in a limited time"; and the laboratory method favorably considered if: "(1) the exercises are short and easy, not complicated as to learning involved or apparatus used; (2) one important objective is the development of laboratory skills; (3) one important objective is the development of ability to solve laboratory problems."

METHODS AND PROCEDURE

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Instruction

The students used in this study were primarily sophmore and junior home economics and hotel administration students enrolled in "Principles of Foods Preparation I". Prerequisites for this course included a beginning course in nutrition and organic chemistry. Although it is preferable to have completed the course in organic chemistry prior to enrollment in the food preparation course, it may be taken simultaneously with the foods course.

Four sections were taught: two by the author and two by a second instructor. Each teacher employed the individual laboratory method in one class and the modified-demonstration method in the other. The work was repeated the following term by the same teachers using four new sections, making a total of eight groups in the experiment. There were approximately twenty students in each group. The sections used in this study were taken from the regular enrollment of classes; two morning and two afternoon sections were used each term. Supplementary instruction by the lecture method was given by a third staff member to all students enrolled in the course, many of whom were not in the experimental laboratory sections.

Stuit and Engelhart (28) have stated that there are several educative factors that influence the effectiveness of instruction and the achievement of the students. Many of these were controlled in so far as it was possible to do so.

Teacher factors. Both staff members teaching the classes were enthusiastic about the use of each method, and every attempt was made to keep class room management similar in both laboratory sections. Each had had previous experience in teaching food preparation.

The control group was taught by the individual-laboratory method (Method "C"). Units of work were assigned for preliminary study; objectives of the lesson and written instructions in the laboratory manual were reviewed briefly. In outlining the work for the period the instructor stressed points where difficulties might arise. The students, usually working individually, but occasionally in pairs, obtained supplies from a central supply table and prepared the products. The teacher assisted students when necessary and answered questions. After the products were judged and discussed, the lesson was summarized and correlated with the lecture and assignment material. Depending on the length of time required for the actual preparation of products, the period of discussion ranged from ten to thirty minutes.

The experimental group, referred to as the demonstration group, was taught by the modified-demonstration method (Method "D"). Individual laboratory practice was included in one-half of the class sessions. As often as possible the teacher-demonstration method was used to present the material. Each lesson so presented was carefully planned, and if any part of the demonstration was prepared ahead of time that part was thoroughly reviewed. The teacher made careful explanation of the work being done. Occasionally students assisted the instructor, thus giving additional experience in laboratory procedures. Class

discussion and questions were encouraged during the demonstration, as well as later when the finished products, either teacher or student prepared, were judged. The discussion, although conducted differently in the control group, covered the same material. In the laboratory periods when the students did not prepare products, a short intermission was given about half way through the period.

General school factors. The laboratory facilities and equipment were the same for six of the eight groups; one group each term used a second laboratory. The equipment in this second classroom, although not identical, was similar to that in the laboratory used by the majority of groups. The periods were all one hour and fifty minutes in length. Occasionally the class finished five or ten minutes ahead of time and the teacher generally utilized this time for reviewing past work. The size of the group, as has been stated, was approximately twenty students, which was the capacity of the laboratory classrooms.

Pupil factors. The method of determining the groups has been discussed at the beginning of this chapter. The students were not aware that two methods of instruction were being compared. This was done in order to prevent a feeling of rivalry, advantage, or disadvantage from developing between the groups. No attempt was made to check extra-curricular activities or course loads of the participating students. Table I shows the distribution of students in each group participating in the study.

TABLE I

DISTRIBUTION OF STUDENTS PARTICIPATING IN THE STUDY

Major Field of Study	Teacher A		Teacher B	
	Method C	Method D	Method C	Method D
Term I				
Home Economics majors	10	12	9	11
Hotel Administration majors	10	7	9	4
Other majors	0	0	2	0
Total	20	19	20	15
Term II				
Home Economics majors	15	8	14	13
Hotel Administration majors	4	9	4	6
Other majors	1	1	1	0
Total	20	18	19	19
Total for experiment	40	37	39	34

Other factors. The same material and sequence of presentation were used for both groups.[1] All students used the same textbook[2] and laboratory manual.[3] A mimeographed sheet giving the outline of study and assignments for the entire term was supplied each student at the beginning of the course.

The major objectives of the course, based on those used previously in teaching this course, were refined to fit both methods of instruction. They are as follows:

> To understand the facts and principles involved in the preparation and use of the foods included in the course of study, with emphasis placed on the physical and chemical properties of these foods.
>
> To interpret and apply facts and principles in terms of the foods prepared in the laboratory.
>
> To learn to prepare different types of food products, with reference to: (1) the development of specific skills and abilities considered important in food preparation, and (2) the recognition of the characteristics of products of standard quality.

Testing Procedures

When considering the type of testing procedures to use in this study, several reliable tests in the field of home economics and in foods and nutrition were reviewed. None was available that was judged valid for this particular work. This resulted in setting as one of the objectives

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[1] For more detailed lesson outlines, see Appendix, pp. 64-74.

[2] M. Miller and M. Barnhart: Essentials of Food Preparation, Dubuque, Iowa: William C. Brown Co., 1947.

[3] E.H. Nason: Laboratory Manual for Foods and Nutrition. East Lansing, Michigan: Michigan State College Press, 1952.

of the study the development of a test to be used as a final written examination.

Since objective-type tests, if well constructed, have been shown to be more reliable than essay-type examinations (39), and because of the ease in correcting, it was decided to construct an objective-type test. A committee consisting of four staff members teaching food preparation classes, including the two teachers involved in the experimental study, was responsible for the test questions. A member of the Board of Examiners at Michigan State College advised the work of this committee throughout.

There are several different types of objective test questions. The committee members wished to avoid using true-false questions for several reasons. It is difficult to construct statements which are not obvious, but at the same time unequivocally right or wrong, and true-false items are often ambiguous. Guessing frequently plays an important part in answering these questions, and if a correction formula is used to reduce the effect of guessing, there is lack of agreement on the right correction formula to use, or how effective such correction is. Finally, many authorities feel that true-false questions are not, as a rule, as discriminating, reliable, or valid as other types of objective questions (39). All test items were multiple-choice and matching type and the approximate number of questions was set at 125 for a two hour final examination. After outlining the topics of study included in the course, the number of questions pertaining to each subject was allocated according to the relative importance of the individual topics. This was determined

on the basis of the amount of class time which had been devoted to studying a certain topic, or preparing a particular type of food product. In this manner it was hoped to have adequate representation and proportionment of the subject matter. Twice as many questions were submitted as would ultimately be needed in order to enable committee members to eliminate test items about which there was lack of agreement. After preliminary editing by the committee, the questions were reviewed by the testing technician who further refined them from the mechanical standpoint. The test in revised form was again submitted to the committee. Awkward sentence structure and other factors which tend to confuse students were eliminated, in addition to writing adequate directions for taking the test. These measures help to increase the reliability of the test. The test was resubmitted to the committee for final approval. This test was taken as the final written examination by all students enrolled in the course both terms, including those students in sections not participating in the study.[1]

After the test had been administered for two terms it was analyzed with respect to: (1) item difficulty--the percentage of students that miss the item, (2) item discrimination--how the item differentiates between the good and poor students, and (3) reliability. The coefficient of reliability was determined by the use of the Kuder-Richardson formula (41).

Other testing procedures used were of the type employed in teaching the course previous terms. These included two one-hour written tests,

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[1] For a copy of the final written test, see Appendix, pp. 76-95.

five short, unannounced tests, a written laboratory test, and a laboratory practical test.

The two one-hour written tests consisted of questions requiring short discussion-type answers. The papers of the students participating in the study were graded by the two laboratory instructors. The key was made as objective as possible, with values for each question determined before the test was administered. One teacher graded the first half of the papers of all students; the second teacher graded the remaining questions. Thus, the same teacher graded the same questions on all papers. Only one question was graded at a time, completing that item on all papers before another questions was graded. Brown (42) has stated that use of the above techniques materially increases the accuracy of scoring this type test.

The five unannounced tests, approximately fifteen minutes in length, were given in all laboratory sections. These were graded with a pre-determined key on the basis of ten points each. The scores were totaled at the end of the term and given a percentage value.

The written laboratory test consisted of four recipes given without directions; the students were required to write the proper procedures to use in preparing the products and the reasons for each important step. The recipes were selected to illustrate as many fundamental principles of food preparation as possible. The two laboratory instructors graded these with a pre-determined key in the same manner as the hour tests.

The laboratory practical test involved the preparation of two products, the recipes for which listed the proportions of ingredients, but no directions for procedures. The assignment was drawn by chance

from the list of products studied in class. The products were judged by a skilled member of the foods staff and by the laboratory instructor using objective score cards based on the "Minnesota Food Score Cards" (43). Only the scores of the outside judge were used in the final treatment of the data since she did not know which method had been used in teaching the respective groups and the instructor might have been biased accordingly in her judgement. The same outside judge assisted throughout the experiment. In addition to preparing the products, the students wrote out full directions for the recipes, giving reasons for each important step. They also graded their products in terms of a standard product. Therefore, the final grade on the laboratory practical test was composed not only of the product scores, but also on the directions and reasons given for the procedure, and the ability to judge a standard product. No talking was allowed throughout the period of examination.

In addition to the scores on the tests mentioned above, the students earned "product grades" throughout the course. While these were considered to be subjective judgements on the part of the instructor, the grades were based on the qualities listed for standard products on the above mentioned food score cards. Although a letter grade was assigned for each product, these grades were converted to a numerical value at the end of the term; use of a numerical grade facilitated the determination of final grades.

The final total score for each student was derived from the following scores, all given as percentages.

Average of two one-hour tests	X 1
Two-hour final test	X 2
Fifteen minute tests	X 1
Laboratory written final test	X 2
Laboratory practical test	X 1
Product grades	X 2
	Final total

Final total ÷ 9 = Final percentage grade

Treatment of Data

The analysis done on the objective-type final written test has been discussed previously in this chapter.[1] The other scores and grades assigned each student were treated in the following manner.

Analysis of variance was carried out on the final grades, on the scores on the final written examination, and on the average scores of the two one-hour tests. The scores on the laboratory practical test were analyzed for significant differences using the Fisher t test.

The number of students in both groups for each teacher was equalized for carrying out the analysis of variance. This was done by omitting the data of three foreign students, four students for whom no T-scores were available, and the rest selected at random.

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[1] For a copy of the final written test, see Appendix, pp. 76-95.

Cost of Food Supplies

Since one of the objectives of the study was to determine the extent to which the cost of supplies could be reduced or more effectively proportioned through use of the modified-demonstration method, a record was kept of the cost of food supplies used for the series of lessons. The market orders were the same for all the demonstration sections and for all the control sections, and identical for both terms. These were cost accounted using the prices in effect at the time the foods were purchased. If large quantities had been purchased for departmental use, the unit cost of the amount used in a particular laboratory lesson was correspondingly reduced.

Organization for Later Use

As was previously stated, this course is the first of a two term sequence. Enrollment in the succeeding course, "Principles of Food Preparation II", is necessary in order to complete all the units of study in the food preparation series. This second term's work is usually followed by a third course in which meal planning and service is studied.

It was planned to record the data from this study in such a way that it might be supplemented with similar data on the same students when enrolled in the succeeding food preparation classes. Thus, a more complete picture of possible differences between the two methods of instruction could be obtained.

Also, if the objective-type test constructed for the final written examination proved to be reliable, it was intended to refine and improve

the test for use in later classes as a final written test, and possibly for use as a pre-test for students transferring from other schools when it is desirable to evaluate previous instruction in food preparation.

RESULTS AND DISCUSSION

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Since the purpose of this study was to determine whether two different methods of teaching would result in significant differences in achievement by students teught by the methods, the data have been analyzed statistically to demonstrate any differences which might exist between the groups.

It has been stated that the groups used in this study were taken from the regular enrollment of classes. The groups in some investigations have been equated by using intelligence quotients, pre-tests, or similar means, but none of these methods was used in this study. It did, however, seem advantageous to check the equality of the pairs of groups instructed each term. The measure used to compare the groups was the T-score based on the college entrance examination scores for each student. Derived from the sums of other scores, the T-score is a measure of general college ability. This score was not available for a small number of students, and the data for those students were not used in later analyses. In addition, the data for three foreign students were considered atypical and were omitted for that reason. The groups used in this experiment, therefore, have not been selective, but the data used for statistical analyses have been limited to some extent for the reasons given above.

The distribution of T-scores is shown in Table II. There appears to be little difference between three of the four pairs of groups. However, the term I demonstration group of Teacher B had a mean value

of 7.0 for the T-scores, and the control group had a mean value of 4.7. It would seem that the demonstration group, in this case, was composed of students of slightly higher ability than the control group.

TABLE II

DISTRIBUTION OF T-SCORES OF STUDENTS PARTICIPATING IN THE STUDY

T-Score	Students Enrolled Term I				Students Enrolled Term II			
	Teacher A		Teacher B		Teacher A		Teacher B	
	Method C	Method D	Method C	Method D	Method C	Method D	Method C	Method D
10	1	0	1	1	1	1	1	0
9	3	3	0	5	2	1	0	1
8	1	2	1	0	4	2	1	4
7	1	1	2	2	2	2	3	2
6	4	3	1	4	3	5	1	4
5	3	2	3	1	1	1	5	1
4	1	3	3	1	1	3	2	2
3	1	2	1	0	1	1	1	2
2	3	2	0	1	0	1	3	1
1	0	0	3	0	2	0	2	2
Average	5.8	5.6	4.7	7.0	6.2	6.0	4.7	5.4

Evaluation of Group Achievement

In order to compare the results of the two methods of teaching, the final grades and the scores on several tests were analyzed statistically to indicate whether any significant differences resulted from the use of the two teaching methods.

The final grades and the scores on separate written tests were treated statistically using analysis of variance. Preliminary analyses carried out on the data for each term showed there were no significant differences between the two methods of teaching, as indicated by the averages of the final grades and also the scores on separate written tests. In addition, there were no significant differences in the results achieved by the two teachers. In 12 out of 16 comparisons the mean score of the demonstration group was slightly higher than the mean score of the control group of the same teacher. However, in no case was this difference significant. The data used for these analyses may be found in Table IX in the Appendix.[1]

The final grades for all the groups used in the study have been combined, as shown in Table III. The analysis of variance carried out on these data is given in Table IV. The weighted averages and the standard errors of the mean were obtained from the data for both terms.

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[1] See Appendix, p. 62.

TABLE III

MEAN SCORES AND RANGES OF THE FINAL GRADES OF STUDENTS PARTICIPATING IN THE STUDY

	Method C			Method D			Weighted Average
	Number of Students	Mean	Range	Number of Students	Mean	Range	
Term I							83.5 ± .71
Teacher A	18	82.8 ± 1.37[a]	70-90	18	85.2 ± 1.37	74-95	84.0 ± .96
Teacher B	15	82.1 ± 1.50	74-90	15	83.9 ± 1.50	75-93	83.0 ± 1.06
Term II							83.1 ± .69
Teacher A	17	82.6 ± 1.41	71-93	17	83.8 ± 1.41	73-91	83.2 ± .99
Teacher B	19	83.3 ± 1.33	73-92	19	82.8 ± 1.33	69-93	83.1 ± .94
Total	69			69			
Weighted Average		82.7 ± .70			83.9 ± .70		

[a] Standard error of the mean, $s_{\bar{x}} = \frac{s}{\sqrt{n}}$

TABLE IV

ANALYSIS OF VARIANCE OF THE FINAL GRADES OF STUDENTS PARTICIPATING IN THE STUDY

Source of Variation	Degrees of Freedom	Sume of Square	Mean Square	F-value
Total	137	4,479		
Between method averages (M)	1	49	49	1.46[a]
Between term averages (T)	1	6	6	.18[b]
Between teacher averages (t)	1	10	10	.30[b]
Interaction T x M	1	27	27	.80
Interaction T x t	1	4	4	.12
Interaction M x t	1	14	14	.42
Interaction M x T x t	1	1	1	.03
Error	130	4,368	33.6	

[a]An F - value of 3.91 would be needed to indicate a significant difference at the five per cent level.

[b]An F - value of 254 would be needed to indicate a significant difference at the five per cent level.

The weighted average of all the control groups was 82.7 ± .70, and the weighted average for all the demonstration groups was 83.9 ± .70. The weighted averages for all groups of both teachers were 83.5 ± .71 for term I and 83.1 ± .69 for term II which indicates a close agreement between terms.

The analysis did not show any significant differences between the two methods of teaching as indicated by the averages of the final grades. In addition, the use of this statistical technique indicated that there were no significant differences between the results achieved by the two teachers, or between terms. There were no significant interactions between the averages of the teaching methods, the teachers, or the terms.

The scores of only one judge were used in analyzing the scores for the laboratory practical test. This person did not know the students, or the method of instruction used with each group. While it would have been desirable to have scores of more than one judge, it was felt that the scores of the instructors might be biased, as they would be acquainted with the students and their work. The final scores were expressed on a percentage basis, because all products were not scored on the same number of points. Table V presents the mean scores and ranges in the practical test for each group.

It will be noted from this table that the mean scores of the demonstration groups were, in all cases, slightly lower than the mean scores of the control groups. However, this difference was not statistically significant according to the Fisher t test. The range of scores in three out of four cases was greater in the demonstration group than in in the control group.

TABLE V

MEAN SCORES AND RANGES ON THE LABORATORY PRACTICAL TEST

	Method C			Method D		
	Number of Students	Mean	Range	Number of Students	Mean	Range
Term I						
Teacher A	18	87.1 ± 2.28[a]	69-100	18	85.1 ± 2.26	67-97
Teacher B	18	82.3 ± 1.75	73 - 95	14	79.6 ± 2.38	61-92
Term II						
Teacher A	15	86.4 ± 2.38	72-97	15	84.0 ± 2.00	71-100
Teacher B	19	83.8 ± 1.92	69-100	19	81.2 ± 2.48	61-100

[a]Standard error of the mean

Teacher B stated that there was a noticeable difference between term II groups in the time taken to complete the practical test; the demonstration group required more time than the control group did.

It would appear from these data that any advantages in demonstrating laboratory procedures did not result in higher scores by the demonstration group on the laboratory practical test. On the other hand, the additional experience obtained by students in the control groups did not appear to result in significantly greater achievement on the same test.

'A review of the data derived from the final grades and other test scores would seem to indicate that on the basis of the measurements used in this study, there were no significant differences between the levels of achievement attained by the groups taught by the two methods.'

For a further comparison of the students participating in this study, the final letter grades earned in Principles of Foods Preparation II were obtained for as many of these students as possible. The method of instruction in the second course is similar to the control method in this study. The comparison of the final letter grades earned in the two courses is shown in Table VI.

It will be seen that the majority of students received the same letter grade in both courses, and a small number of students earned a higher grade in the second course. Thirty-eight per cent of the students from the control groups, as compared to 11 per cent of the students from the demonstration groups, earned lower grades in the second course than in the beginning course.

TABLE VI

COMPARISON OF FINAL LETTER GRADES EARNED IN TWO FOOD PREPARATION COURSES [a]

	Method C		Method D	
	Number	Percentage	Number	Percentage
Cases in which the student earned a higher grade in course II than in course I	1	3	3	11
Cases in which the student earned the same grade in both courses	17	59	22	78
Cases in which the student earned a lower grade in course II than in course I	11	38	3	11

[a] The grades of the students of both teachers have been considered. Grades of ten students were not available.

While this observation might suggest a difference in the retention of knowledge by the two groups, more detailed measurements would have to be made in order to determine any real difference resulting from the use of the two methods of instruction.

Evaluation of the final written test. One of the objectives of the study was to construct an objective-type test suitable for use as a final examination. The questions were based not only on factual knowledge, but also on application of facts and on an understanding of the principles involved in food preparation. After the test had been administered to 184 students, the answer sheets were analyzed to determine the effectiveness of the individual items in the test. From these data two coefficients were computed for each test item: an index of difficulty, and an index of discrimination. These values are incorporated in the copy of the final examination included in the Appendix.[1] In addition, the coefficient of reliability for the test was determined by use of the Kuder-Richardson formula (41). This and other statistical data are given below:

Total number of points	125
Mean raw score	107.61
Standard deviation	8.55
Mean percentage score	86.09
Reliability coefficient	.82

Because these data concerned the characteristics of the test itself, the answer sheets for all students taking the test were used for the analysis. The analysis was carried out under the direction of a representative of the Michigan State College Board of Examiners.

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[1] See Appendix, pp. 76-95.

Generally, the test items are validated by comparing the performance of the good and poor groups of students as shown by test scores. In actual practice it is a long procedure to compute the validity of an item on this basis when the group contains one hundred or more. It is possible to compute accurately the validity of items on the basis of total test scores using an equal proportion of papers of good and poor students, such as the highest and lowest thirds or fourths. Papers for those fifty students having the highest scores and for those fifty students having the lowest scores were used in this analysis. Fifty represents 27 per cent of the total 184. The terms high and low groups refer to the good and poor students whose papers were used in the analysis.

The analysis was done by the Graphic Item Counter attached to one of the IBM test scoring machines. A tabulation was made of the number of students in each group who answered each item correctly. From these data the coefficients for each item were computed. The index of difficulty represents the percentage of students in the combined groups who missed the item. The index of discrimination is an indication of the extent to which an item discriminates between the good and poor students. The complete item analysis serves as a basis for the examiner to judge the usefulness of each item, and is also used in determining the coefficient of reliability.

Reliability is one characteristic of a good evaluation device. This term is often used in conjunction with another characteristic, validity. According to Brown (39) "validity of a test indicates the degree to which

it measures what it claims to measure, whereas, the reliability of a test indicates the accuracy and consistency with which it measures whatever it does measure." Validity of a test as a whole is not easily measured, for it requires correlating the scores made on the test with other outside criteria. Reliability, on the other hand, depends on several factors some of which are inherent in the test itself, such as the number and difficulty of test items. The reliability estimate of this test was computed to be .82. Brown (42) has stated that a reliability coefficient of .80-.89 is adequate for group measurement.

Since most achievement tests are restricted in length by the available time, it is important that every test item adds to the value of the test. It is the purpose of an item analysis to indicate the poor items so that they can be revised or discarded. It is obvious that any item on an achievement test that is passed or failed by everyone contributes nothing to the results of the test. Therefore, the items of zero or one-hundred per centdifficulty should be discarded. Questions 63, 64, 72, 88, and 89 on this test had an index of zero, and ten additional questions had values of one or two for this index. All items of low difficulty need not be discarded from the test, because easy items will help differentiate between poor students, whereas, difficult items will effectively discriminate between good students. It is evident, then, that the use of both easy and difficult items is desirable. The indices of difficulty on the items in this test ranged from zero to 57.

A study of the indices of difficulty revealed that this test was composed of fairly easy items. Eighty per cent of the questions had an index of difficulty below 25, and an index of over 50 was computed on only one item. In general, the matching items were more difficult than the multiple choice questions.

The fact that this test was composed to a large extent of items of low difficulty was also reflected in the mean score. The mean of 107.61 from 125 possible points is comparable to a percentage score of 86.09. A test composed of easy items will group the scores at the high end of the scale, and one composed of difficult items will result in a majority of scores at the low end. However, if one aim of the course is that the students should have a knowledge of all the material given in this test, then a low mean score and high indices of difficulty could indicate faulty instruction or an invalid test.

A study of the distribution of scores on the final written test, as shown in Figure 1, reveals that the curve is skewed toward the higher scores. It has, however, some resemblance to the normal distribution curve.

It has been stated that the index of discrimination is an indication of the extent to which an item differentiates between good and poor students. Discrimination can be classified into three groups: positive, zero, and negative. If an item has a positive index, more good students answer the item correctly than poor students. A discrimination index of zero indicates that an equal number of both groups answer the item correctly, and a negative value shows that more poor students than good

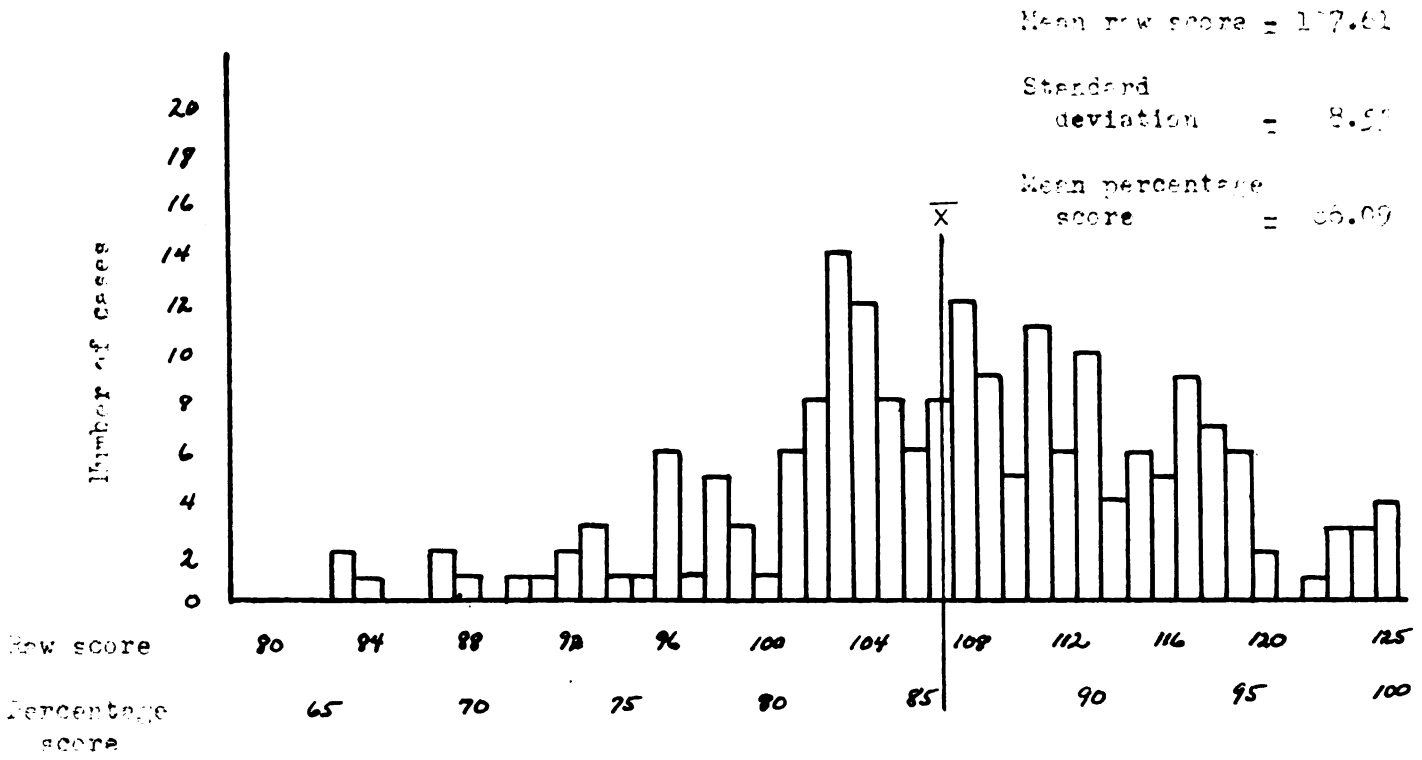

Figure 1. The Distribution of Scores on the Final Evaluation

answer the item correctly. The degree of discrimination depends upon the difference in correct responses by the upper and lower groups. For most tests a discrimination index above .20 will be satisfactory.[1]

A study of the discriminating power of the various items, as shown in Table VII, indicates that the multiple choice items were less discriminating than the matching questions, since 72 per cent of the questions of multiple choice type had satisfactory indices, as compared to ninety per cent of the matching questions. Seventy-five per cent of all items proved to differentiate satisfactorily between the good and the poor students. If an index of .15 is accepted as the standard, which was the value used by Segner (33) in studying achievement in food preparation, eighty per cent of the items on this test would have a satisfactory index of discrimination. Brown (42) has stated that an index of even less than .15 may be regarded as a sufficient difference in the case of very easy or very difficult items.

TABLE VII

ANALYSIS OF DISCRIMINATING ITEMS IN THE FINAL WRITTEN TEST

Type of Question	Total Number of Items	Discriminating Item[a]	
		Number	Per cent
Multiple choice	104	75	72
Matching	21	19	90
Both	125	94	75

[a] Index of discrimination $\geq$ .20

1 Personal communication from Mr. Robert Jackson, Office of Board of Examiners, Michigan State College, East Lansing, Michigan.

In this test a total of 31 items had an index of discrimination below .20. Of these, five had a negative index and eight had a value of zero. If these items should be revised or replaced this should, in turn, raise the discrimination index for the whole test. Simply omitting these items would raise the reliability coefficient for the remaining group of questions. On this test fifty per cent of the discriminating items had an index between .20 and .40, and eighty per cent of the items had an index below .50. The range of index values was -.11 to .70. In general, a greater percentage of the matching questions had higher discriminating power than did the multiple choice questions. In practice a discrimination index of 1.00 will never be obtained.

It should be recognized that easy test items and difficult test items can both be discriminating. The difference lies in the fact that the easy questions differentiate between the poor students and the difficult questions between the good students. Examples of easy questions having a high index of discrimination are numbers 21, 25, and 43. Test items may, however, be of greater difficulty and still not discriminate well between good and poor students. Questions 18, 57, and 100 are examples of this type. It is desirable to have some items which are both highly discriminating and of greater difficulty in order to bring out differences between students in the higher levels. Examples of this type are questions 23, 66, and 59.

Item analysis carried out on test items is valid only for the group whose papers were included in the analysis. Difficulty and discrimination will vary with different groups. However, it is useless to perform an item analysis unless the test items are to be used again. Only after such examination as this can achievement tests be made to measure more accurately the knowledge which it is intended that they measure.

If further use is made of this test, the following measures are recommended to improve it. (1) Discard or rephrase the items of very low difficulty. Replacing these items with questions of greater difficulty would help to increase the discrimination between good students. (2) Discard or rephrase the items having an index of discrimination below .20. This would increase the discrimination index of the test as a whole and raise the coefficient of reliability. (3) After selecting the good items, tabulate the individual responses to each item. Revise or replace incorrect choices that attracted no one. (4) Place the items according to difficulty. Ebel (44) has stated that placing the items of less difficulty at the beginning of a test will encourage the students when starting the test.

As a result of this revision the test would be a more effective device for evaluating achievement of students enrolled in the beginning course of food preparation.

Other Results of the Teaching Methods

Interest is one factor which is difficult to measure, and yet it has a definite influence on both the teacher and the student. Generally speaking, the students in both groups appeared to be interested in the work being done. However, teacher B expressed difficulty in keeping the attention of three or four students in the second term demonstration section. Lack of interest on the part of these particular students did not continue longer than the first two weeks of work, although this instructor stated that the attention of the entire group was more difficult to hold than that of her previous demonstration group.

An interesting comparison was made between the unexcused absences by students in both groups. Only absences from the laboratory were counted. Almost twice as many absences were incurred each term by the students in the control groups as in the demonstration groups. Whether there is a relationship between student-interest and student-absences is not known. It should be recognized that the time of day at which the class met may have been a contributing factor.

Clarity of directions is another factor difficult to evaluate. Both teachers observed that, in many instances, the use of verbal and written directions preceeding individual laboratory work was less effective in teaching food preparation than when demonstration preceeded practice experience. This was especially true when different types of equipment were used, as in the preparation of beverages; or when alternative methods of procedure were involved, as in the preparation of white sauce. Demonstration rather than lecture may be more

meaningful to the student when more than one correct method of procedure may be used.

The demonstration method has the advantage of helping pupils "see" how things are done, and helping them understand the reasons for following certain methods of procedure. A single teaching demonstration may serve many pupils, whereas individual laboratory assistance is more time consuming and meets the needs of fewer students.

Both teachers stated that the practice time for students in the modified-demonstration group should not be reduced. Experience in "doing" is important in this area of study. While the results of this study do not indicate significant differences between the levels of achievement on the part of the modified-demonstration group when compared to the students in the control group, it is possible that any less time in laboratory experience might have resulted in greater differences, especially on the scores of the practical test. It is believed that time and work efficiency will, in some respects, be related to experience, and reducing the laboratory practice time for the modified-demonstration group might result in less proficient work being done in succeeding courses.

Comparison of Costs

A record was kept of the cost of the food supplies used in one laboratory section of each type for one term. The orders were the same for all the demonstration groups and for all the control sections, and identical for both terms. Table VIII gives the comparison of the costs of the food supplies for the series of lessons.

TABLE VIII

COMPARISON OF COSTS OF FOOD SUPPLIES USED FOR ONE TERM

Lesson	Control Group	Modified-Demonstration Group	Difference in Cost
Salads	$ 3.87	$ 3.30	$ .57
Gelatin products	2.02	.82	1.20
Flour and gluten	.19	.19	
Muffins-variations in mixing	2.26	.47	1.79
White sauce, cheese	1.83	1.76	.07
Cereal dishes	4.35	1.60	2.75
Beverages	1.67	1.16	.51
Breakfast eggs	4.26	1.15	3.11
Custards	2.33	.74	1.59
Omelets	1.64	.27	1.37
Souffles	3.51	3.51	
Puddings	2.37	2.37	
Leavenings - baking powder	2.43	.56	1.87
Leavening - baking soda	1.67	.30	1.37
Muffins - standard products	3.80	3.80	
Fruits	1.78	1.12	.66
Candies	2.43	2.43	
Practical test	3.62	3.62	
Total	$46.03	$29.17	$16.86

The total cost for one term for the group taught by the individual laboratory method was $46.03; the total cost for the modified-demonstration group was $29.17 for one term. The difference in cost of the food supplies for the two groups was $16.86, which constitutes a 22 per cent saving in the demonstration group. Since four groups were taught by the modified-demonstration method, the saving for this study was approximately seventy dollars. When one considers that three to six sections of this course are taught every term, the difference in the cost of the two methods assumes considerable importance. Other factors which will influence costs are the size of the classes and the ability of the teacher to plan and order supplies. However, the saving effected by the use of the modified-demonstration method merits attention and consideration.

SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

The author and a second teacher employed two teaching methods to instruct eight groups of college students enrolled in a beginning course in food preparation. Four groups were taught through use of the individual laboratory method; the other four groups were instructed through use of the modified-demonstration method. The individual laboratory method consisted of student preparation of food products after preliminary instruction had been given. The modified-demonstration method utilized teacher-demonstration for presenting the material, combined with supervised practice periods for individual experience in half of the scheduled periods. Additional instruction was given both groups through lecture classes and review sections. Educative factors were controlled in so far as it was possible under ordinary school conditions. The experimental factor was the teaching technique employed in the laboratory classes.

Evaluation of student achievement was made on the basis of scores on written tests, product grades, and a practical laboratory examination. The data were analyzed statistically to see if any differences resulted from the two methods of instruction.

An objective-type test was constructed for use as a final examination. The papers of [illegible] students were analyzed statistically and the data were used to compute the index of difficulty and the index of discrimination for each test item; the coefficient of reliability for the test was also determined.

A record was kept of the cost of food supplies used in the laboratory in order to determine the difference in cost between the two methods of instruction.

Under the conditions of this experiment there was no statistically significant difference between the groups on the basis of either the final grades, the scores made on the final written test, or the average scores of the two one-hour examinations. Analysis of variance carried out on these data indicated that there was no significant difference between the results obtained through use of the two methods of teaching, and also no significant difference between the results achieved by each teacher.

The results of the analysis of the scores on the laboratory practical test, as determined by use of the Fisher t test, indicated that there was no statistically significant difference between the groups. In all cases, however, the mean score of the modified-demonstration group was lower than the mean score of the control group of the same teacher.

The test constructed for use as a final test proved to be a fairly good measure of the students' knowledge of this subject. If an index of discrimination of .20 is used as the standard, 75 per cent of the items satisfactorily differentiated between the good and poor students. The reliability coefficient for the test was computed to be .82.

Recommendations have been made to improve the test in order that it might be a more effective device for evaluating achievement in beginning food preparation.

The cost of the modified-demonstration method was over 22 per cent less than that of the individual laboratory method. Since several laboratory sections of this course are taught each term, considerable saving of money would result through the use of the modified-demonstration method.

Under the conditions of this experiment it is questionable whether the students learned more through the use of one teaching method than through use of the other. However, the results of this study have indicated that the individual laboratory method is not the only effective way for students to learn food preparation. The extent to which teacher-demonstrations can substitute for practical experience in a beginning food preparation course, and at the same time allow the student to gain necessary experience in manipulative skills and techniques, is not definite. More analytical work will be necessary to decide the circumstances under which, and the units of study for which, each method will be most successful. The use of the modified-demonstration method, as it has been carried out in this study, has been judged to be no less effective as a teaching technique than the conventionally used individual laboratory method. In addition, it has resulted in considerable saving of money.

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APPENDIX

TABLE IX

MEAN SCORES AND RANGES OF THE FINAL GRADES AND SCORES ON WRITTEN TESTS BY TERMS

	Term I							
	Teacher A				Teacher B			
	Method C		Method D		Method C		Method D	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Final grade	82.8 ± 1.24[a]	70-90	85.2 ± 1.24	74-95	82.1 ± 1.36	74-90	83.9 ± 1.36	75-93
Final examination score	86.1 ± 1.62	73-95	89.2 ± 1.62	70-100	83.3 ± 1.78	72-94	86.9 ± 1.78	77-100
Weighted average[b] of two one-hour examinations and final examination scores	84.9 ± 1.60	71-95	87.1 ± 1.60	64-99	81.3 ± 1.76	73-92	85.6 ± 1.76	80-98
Average of two one-hour examinations	82.6 ± 2.09	65-96	82.6 ± 2.09	52-98	77.7 ± 2.29	65-90	83.1 ± 2.29	73-96

	Term II							
	Teacher A				Teacher B			
	Method C		Method D		Method C		Method D	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Final grade	82.6 ± 1.51[a]	71.93	83.8 ± 1.51	73-91	83.3 ± 1.43	73-92	82.8 ± 1.43	69-93
Final examination score	88.1 ± 1.50	76-98	87.5 ± 1.50	74-95	85.9 ± 1.42	67-95	88.2 ± 1.42	78-99
Weighted average[b] of two one-hour examinations and final examination scores	87.2 ± 1.57	77-95	85.9 ± 1.57	75-95	82.8 ± 1.49	66-93	85.8 ± 1.49	76-97
Average of two one-hour examinations	85.6 ± 2.18	76-96	82.5 ± 2.18	60-95	76.2 ± 2.06	62-95	81.4 ± 2.06	66-94

[a] Standard error of the mean.

[b] The final examination was weighted two times the hour examinations.

LESSON OUTLINES

Control	Modified Demonstration
Introduction	1a
Introductory discussion - The course - The laboratory	Introduction - Same
Salads and Salad Dressings	1b
	(Individual preparation)
Discussion - Characteristics of good salads - Preparation and service of good salads - Preparation and use of - Salad greens - Tomatoes - Citrus fruits - Peel and section	Discuss - Same Demonstrate - Preparation and use of - Salad greens - Tomatoes - Citrus fruits - Peel and section - Salad examples - Fruit - Tossed
Prepare - Salads (Individuals)	Prepare - Same
Judge products	Judge products
Discuss - Emulsions - Types - Properties - Salad dressings - French dressing -Mayonnaise - Cooked dressing	Discuss - Same Demonstrate - French dressing - Mayonnaise Discuss - Cooked dressing

Control	Modified Demonstration
Gelatin (No individual preparation)	2a
Discuss - Hydration and dissolution of gelatin	
Prepare - Gelatin products (Groups of two) - Whips - Sponges - Bavarian creams - Jellied vegetable salad - Tomato aspic	Demonstrate - Hydration and dissolution of gelatin - Gelatin products using basic lemon jelly - Same, except tomato aspic
Judge products	Judge products
Discuss - Recipe differences - Solutions - Colloidal systems - Gelatin gels - Foams - Egg - Cream	Discuss - Same, plus tomato aspic recipe
Gluten (Individual preparation)	2b
Discuss - Gluten formation	Discuss - Same
Prepare - Gluten balls (Individuals) - Different flours - Added sugar - Added fat	Prepare - Same
Discuss - Factors affecting gluten formation - Techniques of measuring - Flour - Liquid - Fat - Brown sugar	Discuss - Same Demonstrate - Techniques of measuring - Same

Control	Modified Demonstration
Muffins--Mixing (No individual preparation)	3a
Discuss - Mixing - Muffin method - Variations in amount	Demonstrate - Mixing - Muffin method - Variations in amount - Variations in ingredients
Prepare - Muffins (Individuals)	
Judge products	Judge products
Discuss - Overmixing - Ingredients - Purpose - Variations - Changes in baking	Discuss - Same
White Sauce - Cheese Cookery (Individual preparation)	3b
Discuss - Combining starch with liquid - Cold - Hot - Effect of heat on cheese	Demonstrate - Combining starch with liquid - Cold - Hot - White sauce - Effect of heat on cheese - Welsh rarebit
Prepare - White sauce (Individuals) - Welsh rarebit with half of white sauce	Prepare - White sauce (Individuals)
Judge products	Judge products
Discuss - White sauce proportions - Starch cookery and gelatinization - Separation of starch granules - Methods - Uses - Factors affecting - Cheese cookery	Discuss - Same

Control	Modified Demontration
Cereal Dishes (No individual preparation)	4a
Discuss - Methods of combining cereal with liquid - Swelling - Rinsing	Demonstrate - Methods of combining cereal with liquid - Swelling - Rinsing
Prepare - Macaroni, spahetti and rice products; (Groups of two)	- Cooking rice with cream of tartar - Spanish rice - Spaghetti with meat sauce
Judge products	Judge products
Discuss - Rice with cream of tartar - Cereal cookery - Finish starch cookery	Discuss - same
Beverages (No individual preparation)	4b
Discuss - Beverage equipment - Ingredient proportions	Demonstrate - Use of equipment - Ingredient proportions - Coffee - Four methods - Iced - Tea Two methods - Iced * - Cocoa
Prepare - Beverages (Individuals) - Coffee - Tea - Cocoa - Chocolate	
Judge products	Judge products by types as prepared
Discuss - Coffee, tea, cocoa, chocolate - Composition - Brewing	Discuss - Same plus * chocolate recipe

* May prepare cocoa at previous lesson (cereals) to shorten lesson.

Control	Modified Demonstration
Breakfast Eggs (Group preparation)	5a
Discuss - Temperature of egg cookery - Methods	Discuss - Same
Prepare - Breakfast eggs (Individuals) - Creamed egg or Egg in nest	Demonstrate - Groups of two - Two methods each for: hard cooked soft cooked poached scrambled fried eggs - Egg in nest
Judge products	Judge products as prepared
Discuss - Egg cookery - Grading of eggs - Aging of eggs	Discuss - Same
Custard (No individual preparation)	5b
Prepare - Baked custard variations (Individuals) - Stirred custard	Demonstrate - Use of dried milk - Baked custard variations - Ingredients - Temperature - Water bath - Stirred custard - Stages of coagulation - Standard product - Overcooked
Judge products	Judge products
Discuss - Use of dried milk - Egg gels - Formation - Factors affecting	Discuss - Same

Control	Modified Demonstration
Omelets (No individual preparation)	6a
Discuss - Omelets - Puffy - Plain	Demonstrate - Omelets - Puffy - Plain
Prepare - Puffy omelets (Individuals)	
Judge products	Judge products
Discuss - Review egg foams - Review egg cookery - Souffles for next lesson	Discuss - Same
Souffles (Individual preparation)	6b
Prepare - Souffles (Individuals)	Prepare - Same
Judge products	Judge products
Discuss - Review - Egg cookery - Foams - Starch cookery - Cheese cookery	Discuss - Same

Control	Modified Demonstration
Puddings (Individual preparation)	7a
Discuss - Principles of starch cookery egg cookery	Discuss - Same
Prepare - Puddings (Individuals) Apply starch and egg cookery principles	Prepare - Same
Judge products	Juge products
Discuss - Application of principles of starch and egg cookery - Review for hour test	Discuss - Same
Muffins - Baking Powder (No individual preparation)	7b
Demonstrate - Different types of baking powder reactions	Demonstrate - Same
Prepare - Muffins with baking powder variations - Types - Amounts (Individuals)	- Muffins with baking powder variations - Types - Amounts
Judge products	Judge products
Discuss - Baking powders - Types - Ingredients - Reactions	Discuss - Same

Control	Modified Demonstration

Muffin Variations (Individual preparation) 8a

Prepare - Standard product muffin variations (Individuals)	Prepare - Same
Discuss - Leavening - Review baking powders - Baking soda	

Baking Soda Products (No individual preparation) 8b

Discuss - Baking soda reactions	Demonstrate - Baking soda reactions - Cold - Heat - Acid
Prepare - Batters of different pH (Individuals) - Chocolate cup cake - Gingerbread - Cottage pudding	- Effect of changes in pH of batters on chocolate cup cakes
Judge products	Judge products
Discuss - Effect of pH of batter on: Color Texture Tenderness Flavor - Neutralization	Discuss - Same plus other acid and basic batters

Control	Modified Demonstration
Cooked Fruits (No individual preparation)	9a
Prepare - Cooked fruits (Individuals) - Sauces - Baked apples - Stewed fruit	Demonstrate - Sauces - three methods - Baked fruit - Apples - Pears - Bananas - Stewed - two methods
Judge products	Judge products
Discuss - Fruit cookery: preservation of - flavor - shape - nutrients - color - Sugar solutions and osmotic pressure differences as applied to fruit cookery	Discuss - Same
	9b
Vacation	

Control	Modified Demonstration
Crystallization (Individual preparation)	10a
Prepare - Fudge, standard products	Demonstrate - Fudge
- Variations in preparation	Discuss - Variations in preparation
- Optimum cooking, beaten immediately	Prepare - Standard product
- Undercooked, cooled before beaten	
- Overcooked, cooled before beaten	
Judge products	Judge products
Discuss - Theory of crystallization	Discuss - Same
- Factors affecting	
Practical Test	10b

Control	Modified Demonstration
Review and Laboratory Written Test	11A
Review - One hour	Same
Written Test - Approximately 45 minutes - Principles of laboratory preparations.	

OBJECTIVE-TYPE FINAL TEST

OBJECTIVE-TYPE FINAL TEST

202 C Final Test

READ CAREFULLY

Tear this sheet off if you wish but:

1. Please use this sheet for any calculations. Do not mark the test questions.

2. Check the directions at the beginning of each section. (Is there one or more than one right answer?)

3. Mark the answer sheet with heavy black lines.

4. Before leaving this room turn in:

   (a) Your answer sheet
   (b) Your copy of the test questions
   (c) This calculation sheet
   (d) Pencil

5. The test will be scored as follows:
   Total number (125) minus number wrong.

Authors note: The analysis of each test item is recorded at the left of each item using the following key:

$$\frac{a \mid b}{c \mid d}$$

a = Number of high fifty students who marked the item correctly.

b = Number of low fifty students who marked the item correctly.

c = Item difficulty (percentage of students missing the item).

d = Index of discrimination.

202 c
Final Test

For questions 1 thru 93 select the one best answer. Blacken the appropriate space on your number sheet.

1. Which of the following is NOT a characteristic of a Quality A egg?

50 48
2 .23

1. A "stand-up" yolk
2. Small air cell
3. Firm vitelline membrane
4. Thin white

2. Processed cheese is less apt to separate upon heating than is unprocessed cheese because

48 44
8 .23

1. an emulsifier has been added.
2. it is creamier.
3. it contains less fat.
4. it contains less protein.

3. Acid decreases the thickening power of cornstarch because

49 31
20 .61

1. it hydrolyzes the starch.
2. it raises the boiling point of the mixture.
3. it takes up some of the water necessary for maximum gelatinization.
4. it hydrates the starch.

4. The emulsifying agent in mayonnaise is

49 49
2 0

1. oil.
2. vinegar.
3. egg.
4. spices.

5. An example of a gas-in-liquid colloidal system is

43 38
19 .15

1. ginger ale.
2. whipped cream.
3. fog.
4. steam.

6. Egg white functions as a foaming agent because

49 49
2 0

1. it contains a large amount of water.
2. its water content traps the incorporated air.
3. its protein becomes overcoagulated.
4. its protein forms an elastic film around the air bubbles.

7. What characteristic of a muffin batter accounts for the difference in tunnel formation when using different types of baking powder?

45 36
19 .28

1. Moisture content
2. Viscosity
3. Porosity
4. Sweetness

8. During the mixing of a muffin batter the protein of flour is

49 23
29 .70

1. hydrated.
2. hydrolyzed.
3. solubilized.
4. decomposed.

9. Before measuring flour you should sift it

50 43
7 .46

1. not at all.
2. once.
3. twice.
4. three times.

10. The use of which baking powder tends to delay tunnel formation?

46 34
20 .37

1. Tartrate type
2. Phosphate type
3. S.A.S. type
4. None of these

11. Overcoagulation of egg protein is characterized by

50 44
6 .43

1. shrinkage of protein.
2. expansion of protein.
3. tenderization of protein.
4. gelatinization of protein.

12. Which of the following ingredients is NOT found in all types of baking powder?

50 41
9 .51

1. Acid ingredient
2. Starch
3. Sodium bicarbonate
4. Calcium acid phosphate

13. Syneresis is the cause of

50 49
1 .11

1. lump formation in a white sauce.
2. separation of liquid from solids in a custard.
3. staling and deterioration of coffee.
4. tunnel formation in muffins.

14. The chief function of milk in a muffin batter is to

49 46
5 .25

1. give structure.
2. tenderize.
3. act as a solvent and suspension medium.
4. give flavor.

15. The constituent of flour which is present in the largest amount is

47 44
9 .15

1. starch.
2. water.
3. protein.
4. fat.

16. What effect will sugar in a batter have on the gluten formed?

50 49
1 .11

1. It peptizes the gluten.
2. It overcoagulates the gluten.
3. It hydrolyzes the gluten.
4. It gelatinized the gluten.

17. The chief function of fat in muffins is to make them

50 46
4 .35

1. light in texture.
2. tender.
3. brown better.
4. firm.

18. The properties of a colloidal system are due chiefly to which of the following characteristics of the dispersed phase?

35 23
42 .25

1. Solubility
2. Hardness
3. Surface area
4. Acidity

19. If cheese is cooked long or fast

50 49
1 .11

1. it is smooth and creamy.
2. it is easily blended into a product.
3. it is rubbery and stringy.
4. its flavor is enhanced.

20. Egg acts as a thickening agent because

49 50
1 -.11

1. it forms a true solution.
2. it incorporates air.
3. the fat in it is highly emulsified.
4. the protein in it undergoes coagulation.

21. Which of the following baking conditions would be most suitable for baking custard?

50 45
5 .40

1. 300°F.
2. 350°F. using a water bath
3. 350°F.
4. 400°F. using a water bath
5. 400°F.

22. Which of the following temperature ranges would be best for baking bran muffins?

46 37
17 .30

1. 300-325°F.
2. 350-375°F.
3. 400-425°F.
4. 450-475°F.

23. In the preparation of a white sauce the starch gel is stablized by

48 27
25 .53

1. the application of heat in the presence of liquid.
2. the application of heat in the presence of fat.
3. fat.
4. liquid.

24. After cooking cereal products such as rice, noodles, macaroni or spaghetti, one should

48 45
7 .19

1. leave the cereal in the hot cooking water until ready to serve.
2. drain off the hot water and place in the oven to keep warm.
3. drain off the hot water and set cereal aside until served.
4. rinse with running water and reheat, if necessary, before serving.

25. One-fourth cup contains,

50 31
19 .67

1. 1 tablespoon.
2. 2 tablespoons.
3. 3 tablespoons.
4. 4 tablespoons.

26. The thickening of a white sauce is completed when the liquid reaches the boiling temperature because

50 49
1 .11

1. the milk needs no further cooking.
2. maximum swelling of the starch granules has occurred.
3. the fat has completely melted.
4. the salt has completely dissolved.

27. Which of the following methods would be MOST apt to produce a creamy fudge?

49 44
7 .34

1. Sirup cooked to soft ball state; beaten immediately.
2. Sirup cooked to hard ball stage; beaten immediately.
3. Sirup cooked to soft ball stage; cooled and beaten.
4. Sirup cooked to hard ball stage; cooled and beaten.

28. Which of the following would be the LEAST important reason for cooking fruits?

50 46
4 .35

1. To improve or change the flavor.
2. To soften the texture and perhaps increase the digestibility.
3. To intensify the color.
4. To preserve the fruit for future use.

29. The principle structure of a fluffy omelet is

44 46
8-.09

1. an egg gel.
2. a starch gel.
3. an emulsion.
4. a coagulated egg white foam.

30. Starch lumps in a white sauce thickened with cornstarch cannot be removed upon further heating because

50 47
3 .30

1. a layer of coagulated gluten forms around the raw starch in the center of the lump which cannot be penetrated by water.
2. water cannot penetrate the layer of gelatinized starch surrounding the raw starch in the center of the lump.
3. water cannot penetrate the layer of overcoagulated egg surrounding the raw starch in the center of the lump.
4. the starch will be hydrolyzed.

31. Which of the following constituents in coffee and tea is NOT readily soluble in water of simmering temperature?

43 25
32 .42

1. Caffeine
2. Caffeol
3. Tannins
4. Caramelized products

32. The primary cause for the soapy flavor produced in baked products containing excess baking soda is the reaction of sodium carbonate residue with the

40 26
34 .31

1. sugar.
2. liquid.
3. fat.
4. flour.

33. An emulsifying agent whould

49 45
6 .30

1. raise the boiling point.
2. lower the boiling point.
3. raise the surface tension.
4. lower the surface tension.

34. The chief reason for cooking cereal products such as noodles, macaroni, etc., is to

40 28
32 .27

1. gelatinize the starch.
2. improve the flavor.
3. increase the volume.
4. hydrolyze the starch.

35. During the baking of a muffin batter, starch does NOT undergo which of the following changes?

43 29
23 .34

1. Hydration
2. Dextrinization
3. Evaporation
4. Gelatinization

36. Invert sugar is composed of

47 37
16 .36

1. glucose. (dextrose)
2. fructose. (levulose)
3. glucose and fructose.
4. glucose and maltose.

37. Cold water is added to dry gelatin before combining it with hot liquid in order to

45 41
14 .15

1. hydrate the gelatin.
2. dissolve the gelatin.
3. peptize the gelatin.
4. hydrolyze the gelatin.

38. What temperature water should be used when preparing coffee or tea in order to extract the optimum amount of desirable constituents and a minimum of undesirable constituents?

44 45
11 -.04

1. Boiling temperature
2. Slightly below boiling temperature
3. Just above boiling temperature
4. Lukewarm water

39. Which of the following methods would be best to use for preparing cocoa from the following recipe:

50 42
8 .49

2 t. cocoa
2 T. sugar
1/4 cup water
few grains salt
3/4 cup milk

1. Mix all ingredients together and heat over direct flame.
2. Make a sirup of the sugar, cocoa, salt and water; boil for 1-2 minutes stirring continuously; add milk, mix well and heat to serving temperature in a double boiler.
3. Dissolve sugar and salt in hot liquid; add cocoa; mix well and heat over a double boiler.
4. Mix sugar, cocoa, and salt; add hot liquid and boil gently for one minute.

40. Which of the following ions must be furnished by baking poweder in order to produce leavening?

49 41
10 .43

1. Hydrogen ion ≠ tartrate ion.
2. Hydrogen ion ≠ acid phosphate ion.
3. Bicarbonate ion ≠ sulfate ion.
4. Bicarbonate ion ≠ hydrogen ion.

41. From which constituent of flour is gluten developed?

50 40
10 .53

1. Protein
2. Fat
3. Starch
4. Sugar

42. In the preparation of starch thickened sauces mixing starch with which of the following substances is the LEAST effective in separating starch granules?

50 40
10 .53

1. Melted fat
2. Sugar
3. Cold liquid
4. Hot liquid

43. Caramel cornstarch pudding is often more difficult to prepare than chocolate cornstarch pudding because

50 34
16 .63

1. the organic acids present hydrate the starch.
2. the extra sugar makes the pudding sticky.
3. the caramel syrup causes the starch to form lumps.
4. the organic acids present hydrolyze the starch.

44. Which of the following factors does NOT affect crystal formation in the preparation of crystalline candies?

49 36
15 .53

1. The temperature at which it is beaten
2. The addition of non-crystalline substances
3. The viscosity of the sirup
4. The amount of stirring during cooking after the ingredients are completely dissolved

45. In preparing a molded gelatin salad which of the following combinations of ingredients will cause the GREATEST DECREASE in stiffness of the jelly?

45 42
13 .12

1. Grated cabbage, carrots, and celery
2. Pieces of fruit including lemon juice for tart flavor
3. Whipped cream, nuts and marachino cherries
4. Cottage cheese, sliced olives and nuts

46. The constituent of coffee which is primarily responsible for flavor in coffee is

49 40
11 .46

1. tannin .
2. caffeine.
3. caramelized products.
4. caffeol.

47. How much flour should be used per cup of liquid in making a medium thick white sauce?

37 33
30 .09

1. One tablespoon
2. Two tablespoons
3. Three tablespoons
4. Four tablespoons

48. When using buttermilk and baking soda in a recipe what proportion of baking soda would you use for one cup in buttermilk?

45 24
31 .50

1. 1/4 teaspoon
2. 1/2 teaspoon
3. 1 teaspoon
4. 1-1/2 teaspoon

49. Cheese dishes, such as Welsh Rarebit, are cooked at low temperature because cheese

49 48
3 .12

1. is protein in nature and easily overcooked.
2. is porous.
3. melts faster at low temperature.
4. is largely fat.

50. A caramel custard, baked under conditions proper for plain custard exhibits syneresis. Why?

50 42
8 .49

1. The eggs were "old".
2. It wasn't baked sufficiently.
3. The acids in the caramel sauce raise the coagulation temperature.
4. The acids in the caramel sauce lower the coagulation temperature.

51. Which of the following colloidal systems describes a gelatin jelly?

43 27
30 .38

1. Liquid-in-solid
2. Solid-in-liquid
3. Gas-in-liquid
4. Gas-in-solid

52. The constituent of flour which is responsible for thickening white sauce is the

47 42
11 .23

1. protein.
2. starch.
3. water.
4. fat.

53. Tenderness in a muffin may be increased by the addition of more

49 49
2 0

1. fat.
2. egg.
3. flour.
4. water.

54. Compared with a standard product an over-mixed muffin is apt to have a top that is

49 47
4 .19

1. flatter.
2. more peaked.
3. rougher.
4. browner.

55. What could be substituted in an ice-cream freezer to mix with the ice to be put around the freezing container if salt were not available?

43 28
29 .36

1. Egg protein
2. Fat
3. Starch
4. Sugar

56. Excess sugar may decrease the thickening power of cornstarch because

46 43
11 .13

1. it hydrolyzes the starch.
2. it lowers the boiling point of the mixture.
3. it takes up some of the water necessary for maximum gelatinization.
4. it hydrates the starch.

57. The best method for cooking macaroni is in

35 24
41 .23

1. a small amount of rapidly boiling water.
2. a large amount of rapidly boiling water.
3. a small amount of water kept at simmering temperature.
4. a large amount of water kept at simmering temperature.

58. Which one of the following ingredients does NOT help to thicken chocolate pudding?

47 34
19 .42

1. Starch
2. Egg
3. Sugar
4. Chocolate

59. Which of the following substances does NOT interfere with crystal formation in the preparation of crystalline candies?

47 23
30 .59

1. Invert sugar
2. Corn sirup
3. Acid
4. Salt

60. Which of the following INCREASES the stability of a whipped gelatin foam?

45 33
22 .34

1. Sugar
2. Acid
3. Cold temperature
4. Warm temperature

61. In preparing cream sauce which order of combining ingredients would be best to use?

50 44
6 .43

1. Melt fat in the milk; add flour and seasonings.
2. Mix flour and seasoning; add to hot milk; add fat.
3. Add fat, flour and salt to scalded milk.
4. Add flour and seasonings to melted fat; add milk slowly.

62. Contamination of egg whites with some egg yolk prevents a stiff foam from forming because of the presence of what constituent of the yolk?

50 44
6 .43

1. Protein
2. Water
3. Fat
4. Vitelline membrane

63. Tunnels in muffins are caused chiefly by excessive

50 50
0 0

1. fat.
2. sugar.
3. oven temperature.
4. mixing.

64. Essentially the muffin method of mixing is to

50 50
0 0

1. beat the egg and fold in the remaining ingredients.
2. cream the fat and sugar, add the milk, flour and other dry ingredients.
3. mix the combined liquid ingredients with the combined dry ingredients.
4. mix the flour and milk; add the remaining ingredients.

65. One tablespoon contains

50 45
5 .40

1. one teaspoon.
2. two teaspoons.
3. three teaspoons.
4. four teaspoons.

66. When cooked the specified length of time a lemon pie filling (thickened with corn starch) did not seem to be thick enough; cooking was therefore continued. Instead of thickening however, it grew thinner. This was the result of

44 23
33 .48

1. hydrolysis of the starch.
2. hydration of the starch.
3. dehydration of the starch.
4. hydrogenation of the starch.

67. Invert sugar is formed by hydrolysis of

48 30
22 .54

1. glucose.
2. fructose.
3. maltose.
4. sucrose.

68. What is the chief cause for softening of fruit during cooking?

45 33
22 .34

1. Hydrolysis of the sugar
2. Hydrolysis of pectic substances
3. Caramelization of the sugar
4. Peptization of the protein

69. When using S.A.S. type baking powder in the presence of a liquid, approximately what proportion of carbon dioxide may be liberated at room temperature?

42 33
25 .24

1. None
2. Approximately 1/3
3. Approximately 2/3
4. All

70. Which of the following descriptions is NOT characteristic of a good salad?

48 44
8 .23

1. The ingredients, dressing, and plate are cold.
2. The food has an unhandled appearance.
3. The texture of the body of the salad is soft.
4. The salad is colorful and the colors harmonize.

71. In preparing the gravy for a stew which order of combining ingredients would be best to use?

49 45
6 .30

1. Mix flour and seasonings with enough cold liquid to make a smooth, thin mixture, add mixture to the hot liquid of the stew.
2. Add the hot stew liquid to flour and seasonings.
3. Add flour and salt to the hot liquid of the stew.
4. Sprinkle flour over hot liquid of the stew.

72. The structure of a baked custard is due to

50 50
0 0

1. coagulated milk proteins.
2. coagulated egg proteins.
3. the presence of egg fats.
4. the presence of sugar.

73. Gel formation is a property characteristic of

46 44
10 .09

1. colloidal solutions.
2. true solutions.
3. coarse dispersions.
4. no solution.

74. What is the chief reason for the difference in rate of reaction in the 3 general types of baking powder?

47 36
15 .38

1. The rate or ionization of the baking soda
2. The action of heat on baking soda
3. The rate of ionization of the acid ingredient
4. The amount of starch present

75. To prepare grapefruit for an orange and grapefruit section salad how would you remove the skin from the grapefruit?

40 29
31 .26

1. Cut through the skin in quarters and peel.
2. Peel indiscriminantly.
3. Pare the skin with a knife.
4. All of these methods are satisfactory.

76. Most cereal products such as rice, macaroni, etc., when cooked will

47 47
6 0

1. increase in volume 2-3 times.
2. increase in volume 4-5 times.
3. remain the same volume.
4. decrease in volume.

77. The principle structure of a white sauce is

50 47
3 .30

1. an egg gel.
2. a starch gel.
3. coagulated gluten.
4. an emulsion.

78. Which method is preferred in cooking fruit in order to retain its shape and keep it from falling apart?

41 32
27 .23

1. Cook in a large amount of boiling water.
2. Cook in a small amount of boiling water.
3. Cook in a sugar syrup.
4. Cooking by any of these methods is equally effective.

79. To cook in a liquid at a temperature of about 185-200°F. (85-95°C.) is called

46 40
14 .23

1. baking.
2. sauteing.
3. boiling.
4. simmering.

80. The increase in volume due to expansion of gases or steam in a product when it is heated is called

50 49
1 .11

1. coagulation.
2. peptization.
3. hydration.
4. leavening.

81. The process of absorption of water is called

48 37
15 .42

1. coagulation.
2. hydration.
3. hydrolysis.
4. syneresis.

82. The change in the structure of an egg-milk mixture, such as soft-custard, when the temperature progresses beyond the coagulation point is called

50 47
3 .30

1. caramelization.
2. curdling.
3. gelatinization.
4. hydration.

83. A dispersion in which the particles do not affect boiling or freezing points is called a

46 26
28 .51

1. saturated solution.
2. supersaturated solution.
3. true solution.
4. colloidal solution.

84. The hydrated protein of wheat and rye flour is called

48 43
9 .26

1. stabilizing agent.
2. leavening agent
3. gluten.
4. starch.

85. A solution containing particles which cannot be seen under the ultramicroscope is called

48 45
7 .19

1. a colloidal solution.
2. an emulsion.
3. a gel.
4. a true solution.

86. The process of rendering protein insoluble upon application of heat to form a gel is called

49 35
16 .55

1. leavening.
2. coagulation.
3. gelatinization.
4. syneresis.

87. The hydration and swelling of starch granules resulting in an increase in viscosity and development of translucency in starch is called

50 43
7 .46

1. gelatinization.
2. coagulation.
3. hydrolysis.
4. curdling.

88. The resistance to flow of liquids is called

50 50
0 0

1. hydration.
2. hydrolysis.
3. caramelization.
4. viscosity.

89. To heat sugar or food containing sugar until a brown color and characteristic flavor develops is called

50 50
0 0

1. caramelization.
2. peptization.
3. hydration.
4. gelatinization.

90. A solution to which the addition of a crystal of solute will cause precipitation is called

48 35
17 .46

1. an unsaturated solution.
2. a saturated solution.
3. a supersaturated solution.
4. a colloidal solution.

91. To allow a substance such as tea to stand in liquid below the boiling point for purpose of extracting flavor, color, or other qualities is called

50 44
6 .43

1. hydration.
2. scalding.
3. searing.
4. steeping.

92. To heat milk or other liquid to below boiling point is called

50 46
4 .35

1. steeping.
2. marinating.
3. scalding.
4. hydrating.

93. A suspension consisting of a liquid dispersed in a liquid with which it is immiscible is called

50 49
1 .11

1. a foam.
2. a gel.
3. an emulsion.
4. gluten.

Questions 94 through 99: Study the statements in List A. Then select the statement in List B which you feel is most applicable to each condition described in List A. Blacken the appropriate blank on your answer sheet.

List A (Statements)

94. (2) If soda in a recipe is increased, what will be the result on tenderness of chocolate cup cakes?
37 20
43 .35

95. (2) The presence of sugar has what effect upon the coagulation temperature of egg mixtures?
48 36
16 .44

96. (1) A high concentration of egg has what effect upon the coagulation temperature of egg mixtures?
49 33
18 .58

97. (2) If the sugar concentration of a sirup is increased, what will be the result on the boiling temperature of the sirup?
44 32
24 .32

98. (2) If the sugar in a recipe is increased what will be the effect on tenderness of a white cake?
46 39
15 .25

99. (2) If soda in a recipe is increased, what will be the result on redness of color of chocolate cup cakes?
48 35
17 .46

List B

1. There will be a decrease.
2. There will be a increase.
3. There will be little or no change.

100. What change in temperature should be made when baking chocolate cake in a loaf pan as compared to individual cup cakes baked in muffin tins?

36 24
40 .26

1. Use a higher temperature.
2. Use a lower temperature.
3. Make no change.

101. Compare the content of protein in cake flour to that in all-purpose flour.

48 33
19 .49

1. There is less in cake flour.
2. There is more in cake flour.
3. There is the same in both flours.

In the following matching questions, each item in List B may be used MORE than once, but it is NOT necessary to use all the items in the B. Lists.

Questions 102 through 104: Select the correct term in List B which best describes the principal function of egg in each of the products given in List A.

List A (Products)	List B (Functions of egg)
50 47 3 .30 102. (3) Mayonnaise	1. Thickening agent
40 41 10 .43 103. (2) Lemon snow pudding	2. Foaming agent
	3. Emulsifying agent
50 45 5 .40 104. (1) Chocolate pudding	

Questions 105 through 110: Select from List B the primary chemical composition of the food products given in List A.

	List A (Food Products)	List B (Chemical Composition)
20 23 57 -.06	105. (3) Cereal products	1. Carbohydrate
42 24 34 .40	106. (2) Gelatin	2. Protein
49 36 15 .53	107. (2) Gluten	3. Carbohydrate / Protein
42 39 19 .09	108. (4) Whole egg	4. Protein / Fat
44 27 29 .41	109. (3) All-purpose flour	5. Fat
39 24 37 .33	110. (4) Cheese	

Questions 111 through 115: Study the two custard recipes given below. Answer the following questions by using the key on the right hand side.

Custard A	Custard B
1 cup milk	1 cup milk
2 eggs	1 egg
2 T. sugar	2 T. sugar
1/2 t. vanilla	1/2 t. vanilla

Key

1. The statement applies to custard A.
2. The statement applies to custard B.
3. The statement applies to both custards.
4. The statement applies to neither custard.

41 21 38 .43	111. (1) Will be most likely to show syneresis.
50 32 18 .66	112. (1) Will coagulate sooner.
42 20 38 .47	113. (2) Will be more tender.
48 39 13 .38	114. (1) Will form a firmer gel.
49 42 9 .40	115. (3) The egg functions as a thickening agent.

In the following set of questions choose the best TWO answers. Black TWO spaces on your answer sheet for each question.

116. In preparing which two products would quality A eggs by necessary?

50 41 9 .51	1.	Cake	50 46 4 .35
	2.	Saute egg	
	3.	Scrambled eggs	
	4.	Poached egg	

117. Which two products listed in #116 could be prepared satisfactorily from B or C quality eggs?

50 44 6 .43	1.	1-3	50 42 8 .49

118. Which two of the following will weaken the stability of an egg white foam?

50 42 8 .49	1.	Overbeating	49 42 9 .40
	2.	Thick egg white	
	3.	Fat	
	4.	Salt	

119. Which two of the following statements are the main principles of egg cookery?

50 40 10 .53	1.	Cook at high temperature.	49 35 16 .55
	2.	Cook at low temperature.	
	3.	Cook a long time.	
	4.	Cook a short time.	

120. Which two properties of eggs enables them to be used as an emulsifying agent?

50 45 5 .40	1.	Forms a foam.	48 41 11 .33
	2.	Lowers surface tension.	
	3.	Soluble in both liquids.	
	4.	Soluble in one liquid and insoluble in the other liquid.	

Author's note: The total number of questions is 125; questions 116 through 120 require two answers for each.