A STUDY OF THE EFFICIENCY OF FOOD PRODUCTION IN COLLEGE KITCHENS

by

Sallie Scott

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Department of Home Economics

APPROVED:

Director of Graduate Studies

Dean of Agriculture

APPROVED:

Head of Department

Major Professor

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Chapter I

Introduction

"Today's kitchen is a scientifically planned production unit -- an efficient workshop with good equipment, adequate refrigeration, a well designed equipment layout, from which food production can be carried on without waste motion, and modern methods of sanitation can be practiced. It is a kitchen well lighted and well ventilated to give the best possible working conditions."[1]

This is a description of the ideal kitchen, but many of our small colleges have kitchens that do not measure up to these standards. From experience obtained as dietitian at Lynchburg College before this investigation was begun, it was the opinion of the writer that much could be done to increase the work efficiency of the kitchen employees by improving their work techniques, the equipment, and the arrangement of this equipment.

Purpose

This study was planned (1) to find out the existing conditions that make for efficiency in food production in colleges enrolling twelve

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1. Margaret L. Mitchell, "Achieving Quality Food Production in Today's Kitchen". Journal of American Dietetic Association 25:1032, 1949.

hundred students or less and (2) to work out a plan that would as nearly as possible meet the description of an ideal kitchen.

Review of Literature

In many instances throughout the country, people are studying ways to get more for their money in food production in institution kitchens. According to Scheps[2], efficient and economical food service depends upon cooperation of the dietitian, the representative of the manufacturer, and the plant maintenance engineer. In addition, the following factors must be considered in placing equipment: (a) easy work accessibility for employees, (b) steady and smooth flow of food preparation, (c) ease and economy of equipment servicing.

McIntyre[3] used plant models to scale in arranging a proposed kitchen layout. It was found that in this way the administrator could avail himself of practical experience in arranging units, and many of the employees who could not read blueprints could gain an understanding of the layout. He concluded that production efficiency and safety of the proposed building could be more economically achieved in finishing the layout when small models were used for planning.

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2. C. Scheps, "Consultations That Bring Efficiency to Hospital Kitchens". Hospitals 23:64, 1949.

3. D. L. McIntyre, "Visualization; Transparent Models For Efficient Plant Layout." Baker's Helper 90:57, 1948.

Mock[4] has translated walking into terms of dollars and cents. His figures show that in one situation production cost was cut by two-thirds by installing additional water taps so the workers did not have so far to walk. Mason[5] developed a new dishwashing system in a Hartford, Connecticut, industrial cafeteria which (a) took dishwashing entirely out of the kitchen and removed that responsibility from the kitchen staff, (b) had soiled dishes "bussed" by the diners themselves, and (c) had dishes washed as fast as they were bussed. At Herman Hospital[6] electric-eye doors were installed between dishwashing and kitchen areas. Equipment was moved away from the wall and rolling utility-work tables were provided with stops which lock to make stable work tables.

In addition to these factors, Otto[7] found that improved production, higher employee morale, better sanitation, elimination of hazards, and reduced maintenance all were possible through the use of proper color in the plant. Modern application of color makes use

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4. R. D. Mock, "What It Costs To Walk". American Restaurant Magazine 22:90, 1948.

5. R. S. Mason, "Dis-assembly Line Speeds Dishwashing Service". Modern Hospital 71:112, 1948.

6. "Expansion Paves Way For Prize Winning Dietary Department". Institutions 24:58, 1949.

7. W. F. Otto, "Choose Proper Colors--Raise Plant Efficiency". Food Industry 21:88, 1949.

of the inherent energy of each hue. The inevitable white color causes blinking and induces fatigue while colors that give a sanitary air can also be pleasant and restful to the eye.

Organization is the mechanism through which management directs, coordinates, and controls business. Fish[8] found that the basic problem in achieving sound management was sub-dividing responsibilities and insuring that these components were properly integrated. According to Fish, a well designed master chart was half the organization plan; the other half was defining the basic obligations of each key position under the plan and stating the principal responsibilities, relationships, and the extent of authority each position was expected to exercise. He further stated that it was necessary for key personnel to have a thorough understanding of the plan and program and indoctrination. Responsibility seems to be a stimulating force in developing able people to full assignment, and a major factor in attracting and keeping able employees interested and satisfied in their work.

Job evaluations are necessary to bring about better labor relations, to aid in training new employees, and to furnish a practical method of placing price on each job. Kaufman[9] included employees and department heads on the committee to devise job rating plans. The committee rated

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8. L. Fish, "Organization—Foundation of Management". Advanced Management 11:52-56, 1946.

9. G. N. Kaufman, "Cutting Payroll Costs By Means of Modern Wage Controls". Hotel Management 50:44-45, 1946.

the jobs and wages accordingly and set up the promotion schedules and span of wages. Promotions and wages were based on the merit rating by the supervisors.

Northrop[10] stated that service to the public should be at a price the public can pay. To make this possible, efficiency is necessary.

From the literature reviewed, it appears that the following factors are important in developing efficient institution management:

1. Planning for use of kitchen space with scale models.
2. Motion-time studies of labor and equipment layout.
3. Careful use of color to promote pleasant and restful surroundings.
4. Job analysis and organization.
5. Cooperative planning by management and personnel.

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10. M. W. Northrop, "Increasing Returns From Payroll Investment". Journal of American Hospital Association 23: 69, 1949.

Chapter II

Procedure

The purpose of this investigation was to determine the factors that might affect the efficiency of food production in college feeding. This study includes thirty-three colleges having an enrollment of twelve hundred students or less. A list of the schools included in this survey may be found in the Appendix on pages i and ii.

In the fall of 1950 a questionnaire of pertinent facts concerning the arrangement of kitchen equipment was sent to the dietitians of seventy-five colleges enrolling twelve hundred students or less in the Southern Association of Colleges and Secondary Schools. This questionnaire, a copy of which is included in the Appendix on pages iii through x, covered such factors as the type and number of meals served; the number, education, and wages of the kitchen employees; and the kind of equipment in use. The dietitians were also asked to furnish a layout of their kitchens.

Of the seventy-five questionnaires sent out on November 20, 1950, only eighteen were returned by January 1, 1951, and many of those questionnaires returned were incomplete. The writer, in January, sent a memorandum to each dietitian who had not yet returned the schedule, asking that she do so if time permitted. The investigator in this study has no way of knowing the reason why so few responses were obtained. It could be due to many factors

such as: overwork, inefficient office help, indifference, etc.

From experience obtained by working in a college kitchen before this investigation was begun, it was the opinion of the writer that much could be done to increase the work efficiency of kitchen employees by improving the techniques, equipment, and arrangement of equipment. At the time the questionnaire was sent to the dietitians in the Southern Association of Colleges and Secondary Schools, the purpose of this investigation was explained; when the cooperation of each dietitian was solicited in obtaining information, the writer offered to furnish a copy of the results of this study to any interested persons. Those dietitians who responded to the questionnaire almost unanimously requested a copy of results. This expression on the part of the dietitians strengthened the writer's belief that much needs to be done to improve the efficiency of operations in college kitchens.

Since only eighteen of the questionnaires were received from the requests to the colleges in the Southern Association of Colleges and Secondary Schools, additional questionnaires were sent to twenty-five colleges of similar size recognized by their respective associations of colleges and secondary schools, in the states of West Virginia, Ohio, Oklahoma, and Arkansas. Out of these twenty-five questionnaires, eight were returned. After requests for information had been sent to colleges in West Virginia, Ohio, Oklahoma, and Arkansas, replies were received from seven additional colleges in the Southern Association of Colleges and Secondary Schools.

In this study, the thirty-three questionnaires obtained have been analyzed to determine factors affecting the work efficiency in college kitchens. From the opinions of the college dietitians using the equipment, the results were tabulated to show the equipment most satisfactory for the number of meals served. From the compiled diagrams, and from the opinions of the dietitians completing the questionnaires a plan for what seems to be the most satisfactory arrangement of equipment for efficiency of food production was worked out for use in small college kitchens with the hope that the plan might be of benefit.

Chapter III

Discussion of Results

The word efficiency has been defined as: "Getting the most done of the best quality, at the lowest cost".[11] From this definition of efficiency it seems that the number of meals that could be served per employee in an efficient kitchen set-up should be greater than the meals served in an inefficient kitchen. In this study the total meals served per employee per day has been used as a basis for analyzing efficiency. Table I on page 10 shows that actually there is a significant relationship between the number of meals served and the total number of kitchen employees, irrespective of the type of food service used.

From the thirty-three questionnaires returned it was found that three types of food service were used for meals. Thirteen schools used Cafeteria Style Service, fifteen schools used Family Style Service, and five schools used a combination of Cafeteria-Family Style Service. Combination Cafeteria-Family Style Service means that one or two of the three meals per day were served Cafeteria Style and the other meal or meals were Family Style Service. Analysis was made of the relationship of the type of service to the number of meals served (1) per waiter, (2) per kitchen employee and (3) per kitchen and dining room employee.

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11. Definition given by Dr. Otto Fredrickson, Professor of Sociology at Madison College, Harrisonburg, Virginia.

Table I

NUMBER OF EMPLOYEES IN RELATION TO NUMBER OF MEALS SERVED PER DAY

Meals Per Day	0-25*	26-50	51-75	76-100	101-125	126-150	Totals
250-500	3	0	0	0	0	0	3
501-750	5	1	0	0	0	0	6
751-1000	2	5	0	0	0	0	7
1001-1250	1	3	0	0	0	0	4
1251-1500	2	1	2	0	0	0	5
1501-1750	0	1	1	0	0	1	3
1751-2000	0	1	0	0	0	0	1
2001-2250	0	2	0	1	0	0	3
2251-2500	0	0	0	0	0	0	0
2501-2750	0	0	0	1	0	0	1
Total	13	14	3	2	0	1	33

$X^2 = 63.1834$
$P < .01$

*Number of employees

Table II on page 12 shows that there is a definite relationship between the number of waiters and the type of food service. The results of this study show that for the thirteen schools reporting Cafeteria Style Service, four waiters were required to serve one hundred meals; while for the fifteen schools using Family Style Service, seven waiters were required to serve one hundred meals. When the relationship of the kitchen employees to the type of food service was studied, there was no sngnificant relationship, as is shown by Table III on page 13. When these groups were combined, Table IV on page 14 shows that the total number of kitchen and dining room employees tends to be related to the type of food service used.

It was thought that there would be some relationship between the efficiency of employees and education of employees. Table V on page 15 shows that if any relation exists, it is a negative relationship. In other words, those employees with the least education served more meals than those employees with more education. If these results are significant and representative, they seem to indicate that the employees did not get the proper training in school for this type of work, or they were not able to apply the learnings made in the classroom to situations occurring later on the job. The average grade school level of the employees studied was found to be the sixth grade.

It was thought that possibly the employees would be paid in proportion to their efficiency as related to the number of meals served per

Table II

TYPE OF SERVICE IN RELATION TO
NUMBER OF MEALS PER WAITER

Number Meals Per Waiter	Cafeteria	Cafeteria Family	Family	Total
0-50	4	3	11	18
51-100	4	0	4	8
101-150	4	1	0	5
151-200	1	1	0	2
Total	13	5	15	33

$$X^2 = 12.8545$$

$$P < .05$$

Table III

TYPE OF SERVICE IN RELATION TO NUMBER OF MEALS PER EMPLOYEE IN KITCHEN

Meals Per Employee	Cafeteria	Cafeteria Family	Family	Total
0-50	1	0	0	1
51-100	2	3	3	8
101-150	3	0	4	7
151-200	0	1	3	4
201-250	3	0	1	4
251-300	1	0	0	1
Totals	10	4	11	25

$X^2 = 11.9801$
$P > .20$

Table IV

RELATION OF TOTAL NUMBER OF EMPLOYEES TO TYPE OF FOOD SERVICE

Number Meals Per Employee	Cafeteria	Cafeteria Family	Family	Total
0-25	6	1	6	13
26-50	6	2	6	14
51-75	1	1	1	3
76-100	0	0	2	2
101-125	0	0	0	0
126-150	1	0	0	1
Total	14	4	15	33

$X^2 = 14.9566$

$P > .05$

Table V

RELATION OF EDUCATION OF HELP TO NUMBER OF MEALS PER EMPLOYEE

Education*	0-100	101-200	201-300	Totals
0-10	2	1	0	3
11-20	3	5	3	11
21-30	1	2	1	4
31-40	1	1	0	2
Totals	7	9	4	20

$X^2 = 3.8807$

$P > .70$

*Total education of kitchen according to code found in appendix on page xiv.

employee. Table VI on page 17 shows that there is very little relation between the compensation received by the employees and the efficiency of the employees. The average pay of all the employees was found to be one hundred seven dollars per month. No school with pay below five hundred dollars per year had employees serving more than one hundred meals per employee per day. Likewise, no school paying above seventeen hundred and fifty dollars per year had employees serving more than one hundred meals per employee per day. In other words in these two groups there were as many employees operating efficiently that received minimum wages as those receiving top salary. However, five schools paying between five hundred dollars and twelve hundred and fifty dollars had employee efficiency above two hundred meals per employee per day.

It was believed that there might be some relationship of salary scale of the dietitians to the number of meals served per employee. It was assumed that the dietitians would be paid in proportion to the number of meals served and their ability to train employees efficiently. The average salary of the dietitians was three thousand and eighty dollars per year. Table VII on page 18 shows little relationship of salary of the dietitians to the number of meals per employee in this study. However analysis of this table does indicate a tendency toward relation of dietitians salary to employee efficiency. No dietitians with a salary less than twenty five hundred dollars had employees serving more than one hundred meals per employee per day, and only one dietitian with a yearly salary larger than nine hundred dollars had employees serving more than one hundred meals daily. This could be due to a number of

Table VI

RELATION OF COMPENSATION OF HELP TO NUMBER OF MEALS PER EMPLOYER

Yearly Wages	0-100 *	101-200	201-300	Total
$ 250-500	2	0	0	2
501-750	3	2	2	7
751-1000	0	3	2	5
1001-1250	0	1	1	2
1251-1500	0	2	0	2
1501-1750	1	1	0	2
1751-2000	1	0	0	1
Total	7	9	5	21

$$X^2 = 12.1418$$

$$P > .30$$

*Number meals served per day

Table VII

RELATION OF SALARY OF DIETITIANS TO NUMBER OF MEALS SERVED PER EMPLOYEE

Managers Salary	0-100	101-200	Total
$ 1500-2000	1	0	1
2001-2500	5	0	5
2501-3000	5	1	6
3001-3500	1	1	2
3501-4000	3	3	6
4001-4500	1	1	2
Total	16	6	22

$X^2 = 4.8402$

$P > .30$

factors, such as (1) lack of specialized training, (2) lack of sufficient assistance, (3) high employee turn-over, (4) lack of interest in the job, etc.

It was believed that there might be some relationship between the labor saving devices used in the kitchens and the number of meals served per employee. These devices include ranges, and other cooking equipment; kitchen machines such as mixers, slicers, and food grinders; dishwashers, glass washers, and silver machines. Table VIII on page 20 shows a definite relationship between the number of meals served per employee and the number of labor saving devices. In most instances, twelve to fifteen of these devices were used to serve one hundred meals per employee per day. If these data are significant and representative, it seems advisable to invest more money in labor saving devices than in additional employee help.

It was assumed that there should be some relationship between the size of the work unit and the efficiency of the workers. For example, some kitchens had one baker in a very large baking area, while others may have had three or more bakers working in a small space. Of the thirty-three questionnaires returned, only fourteen included a diagram of kitchen lay-out. An analysis of these fourteen lay-outs was made in relation to the size of the meat and vegetable cooking area, the baking area, and the dishwashing area. Table IX on page 21 shows the relationship of the number of cooks to the area for cooking. This relationship is very significant. This table indicates that the most cooks worked in the smallest areas. Eight of the fourteen cooks worked in areas smaller

Table VIII

RELATION OF NUMBER OF LABOR SAVING DEVICES TO NUMBER OF MEALS PER EMPLOYEE

Number Devices	0-100	101-200	201-300	Total
5-10	0	1	0	1
11-15	12	2	1	15
16-20	2	4	0	6
21-25	0	1	4	5
26-30	0	4	0	4
Total	14	12	5	31

$X^2 = 34.5796$

$P > .01$

Table IX

RELATION OF SIZE OF COOKING AREA TO NUMBER OF COOKS[12]

Number Cooks	201-300	301-400	401-500	501-600	601-700	701-800	801-900	901-1000	1001-1100	Total
2	0	1	0	0	0	0	1	0	1	3
3	1	1	0	0	0	1	0	0	0	3
4	2	1	0	0	2	0	0	0	0	5
5	0	1	0	0	0	0	0	0	0	1
6	0	0	0	0	0	0	0	0	0	0
7	1	0	0	0	0	0	0	0	0	1
8	0	0	0	0	0	1	0	0	0	1
Total	4	4	0	0	2	2	1	0	1	14

$X^2 = 47.8867$

$P < .01$

12. Cooking area is given in square feet.

than four hundred square feet. The number of bakers, however, has very little, if any, relation to the size of the baking area as shown in Table X on page 23. The number of dishwashers has a definite relationship to the size of the dishwashing area. As shown in Table XI on page 24, the largest numbers of dishwashers were located in the smallest areas.

It seemed that there should be some relationship between the number of ranges and the number of people served. In this study one range was required for every three hundred thirty-nine meals served. Table XII on page 25 shows that there is a high relationship between the ranges and the number of meals served.

Likewise, it seemed that there should be a direct relation between the number of meals served and the number of dishwashing machines. Table XIII on page 26 shows that in the thirty schools reporting the use of dishwashing machines, there is no relationship between the number of dishwashing machines now in use and the number of meals served. Since most schools reported the use of one machine without specifying the size, this may mean that the larger the school, the larger the dishwasher; whereas the larger schools used more ranges, probably since commercial ranges are usually purchased in sections all the same size.

Thirteen schools reported the colors used in the kitchens. Table XIV on page 27 shows the relation of color of kitchen to employee efficiency. Analysis of this table shows that there is little or no relationship between the color of the kitchen and the efficiency of the workers as shown by the number of meals served per employee. The colors

Table X

SIZE OF BAKING AREA IN RELATION TO NUMBER OF BAKERS[13]

Number Bakers	0-200	201-400	401-600	601-800	Total
1	3	0	2	0	5
2	0	2	0	2	4
3	1	0	0	0	1
Total	4	2	2	2	10

$X^2 = 9.2800$

$P < .20$

13. Size of baking area is given in square feet.

Table XI

RELATION OF SIZE OF DISHWASHING AREA TO THE NUMBER OF DISHWASHERS[14]

Number Dishwashers	100-150	151-200	201-250	251-300	301-350	351-400	401-450	451-500	501-600	601-650	Total
2	1	0	1	0	0	1	0	0	0	1	4
3	0	2	0	0	1	0	0	1	0	0	4
4	1	0	0	1	0	0	0	0	1	0	3
5	1	0	1	1	0	0	0	0	0	0	3
Total	3	2	2	2	1	1	0	1	1	1	14

$$\chi^2 = 59.3171$$

$$P < .01$$

14. Size of dishwashing area is given in square feet.

Table XII

NUMBER OF RANGES IN RELATION TO NUMBER OF MEALS SERVED PER DAY

Number Ranges	400-* 600	600-800	801-1000	1001-1200	1201-1400	1401-1600	1601-1800	1801-2000	2001-2200	2201-2400	Total
0-2	5	2	0	0	0	0	1	0	0	0	8
3-4	0	5	0	3	1	0	2	0	1	0	12
5-6	0	0	0	1	0	2	0	0	1	1	5
7-8	1	0	0	0	0	0	0	0	0	0	1
Total	6	7	0	4	1	2	3	0	2	1	26

$X^2 = 53.6999$

$P < .01$

*Number meals per day

Table XIII

NUMBER DISHWASHING MACHINES IN RELATION TO NUMBER SERVED

Number Machines	401-600	601-800	801-1000	1001-1200	1201-1400	1401-1600	1601-1800	1801-2000	2001-2200	2201-2400	Total
0-2	6	8	1	4	2	2	3	1	1	1	29
3-4	0	0	0	0	0	0	0	0	1	0	1
Total	6	8	1	4	2	2	3	1	2	1	30

$x^2 = 7.1855$

$P < .50$

Table XIV

RELATION OF COLOR TO NUMBER MEALS PER EMPLOYEE

Number Meals Per Employee	White and Grey	Buff and White	Total
0-50	1	0	1
51-100	4	1	5
101-150	1	1	2
151-200	1	3	4
201-250	0	1	1
Total	7	6	13

$X^2 = 4.8569$

$P < .30$

used were white, buff, grey, and combinations of these three. Possibly a larger sample of colors should be studied to give conclusive evidence of the relation of color in the kitchen to work efficiency. The results of this study are not in agreement with the study made by Otto[15] in which he found a direct relationship between production and color used in the kitchen. Again, this disagreement could be due to the fact that so few colors were reported in this study. If colors other than white tend to increase production, the fact that many of the schools included in this study reported the use of white or grey could be a factor in the seeming inefficiency of the average operation.

It was thought that there would be some relation between the size of the different work areas and the number of meals served. Table XV on page 29 shows that there is no relationship between the size of the cooking area and the number of meals served. Likewise, Table XVI on page 30 shows that there is very little or no relationship between the size of the baking area and the number of meals served per employee. Table XVII on page 31 shows that there is very little relationship between the size of the dishwashing area and the number of meals served per employee.

Chart 1 on page 32 is a scattergraph showing the center of each working area in the kitchen. From observation of this chart, it

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15. W. F. Otto, "Choose Proper Colors - Raise Plant Efficiency". Food Industry 21:88, 1949.

Table XV

RELATIONSHIP OF SIZE OF COOKING AREA TO NUMBER MEALS SERVED PER EMPLOYEE[16]

Number Meals Per Employee	201-250	251-500	501-750	751-1000	1001-1250	1251-1500	1501-1750	1751-2000	2001-2250	Total
0-50	0	1	0	0	0	0	0	0	0	1
51-100	1	4	1	0	0	0	0	0	0	6
101-150	0	2	1	1	1	0	0	0	0	5
151-200	0	0	0	0	0	0	0	0	1	1
201-250	0	1	2	0	0	0	0	0	0	3
Total	1	8	4	1	1	0	0	0	1	16

$X^2 = 26.8606$

$P > .70$

16. Size of cooking area is given in square feet.

Table XVI

RELATIONSHIP OF BAKING AREA TO NUMBER OF MEALS SERVED PER EMPLOYEE[17]

Number Meals Per Employee	0-250	251-500	501-750	751-1000	Total
0-50	1	0	0	0	1
51-100	4	0	0	1	5
101-150	4	1	0	0	5
151-200	0	0	0	0	0
201-250	0	1	1	1	3
Total	9	2	1	2	14

$X^2 = 9.9754$

$P > .70$

17. Size of baking area is given in square feet.

Table XVII

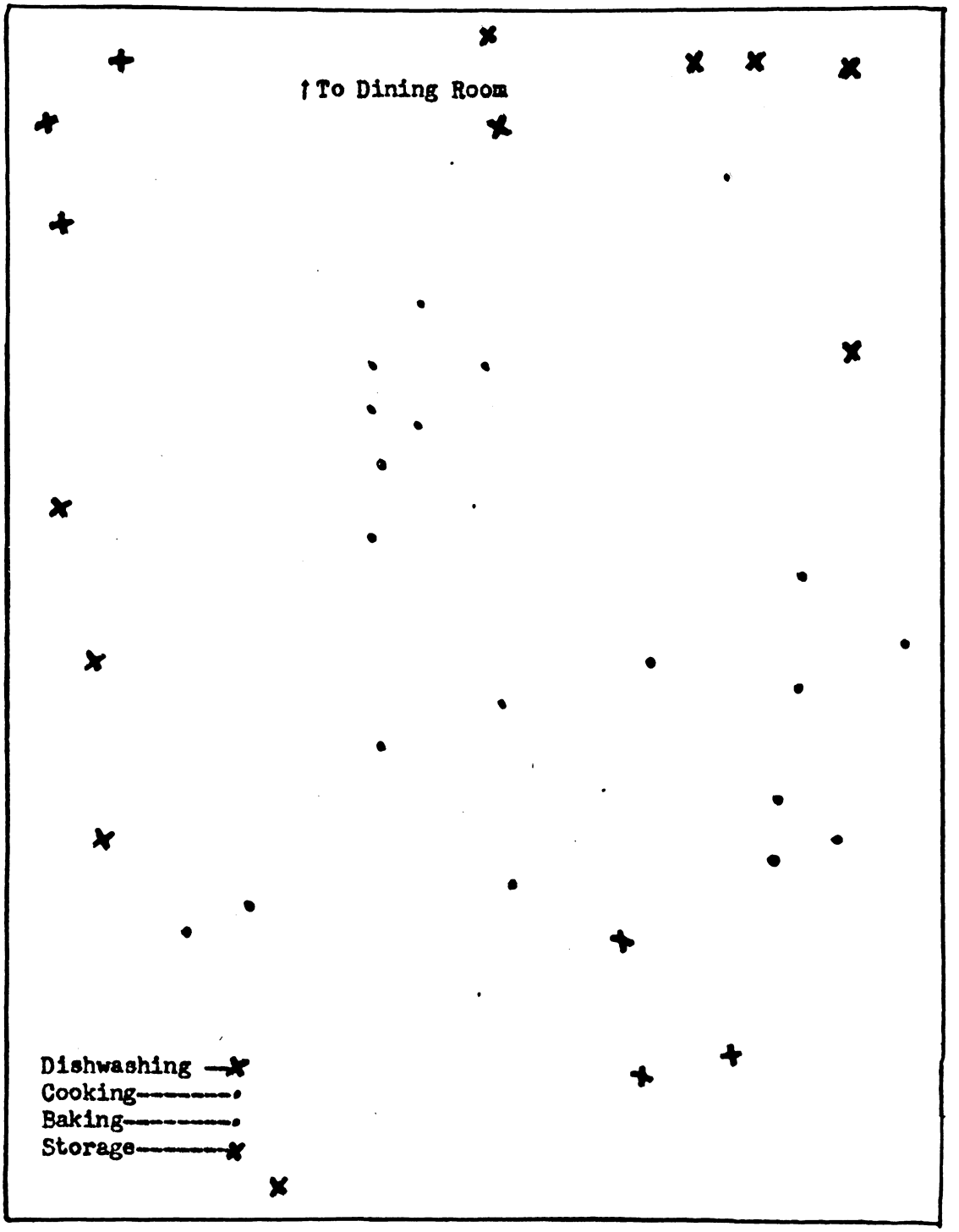
RELATIONSHIP OF SIZE OF DISHWASHING AREA TO NUMBER OF MEALS SERVED [18]

Number Meals Per Employee	1-100	101-200	201-300	301-400	401-500	501-600	601-700	Total
0-50	0	1	0	0	0	0	0	1
51-100	0	4	1	0	0	0	1	6
101-150	0	2	2	0	0	1	0	5
151-200	0	0	1	0	0	0	0	1
201-250	1	0	0	1	1	0	0	3
Total	1	7	4	1	1	1	1	16

$X^2 = 25.1197$

$P < .50$

18. Size of dishwashing area is given in square feet.



Relative Positions of Centers of Work Areas for Fourteen College Kitchens

Chart 1

can be seen that college kitchens tend to locate certain work areas in definite relationship to the dining room and to each other. However, this chart also shows that work areas in different college kitchens do not coincide, even though they seem to be related to each other.

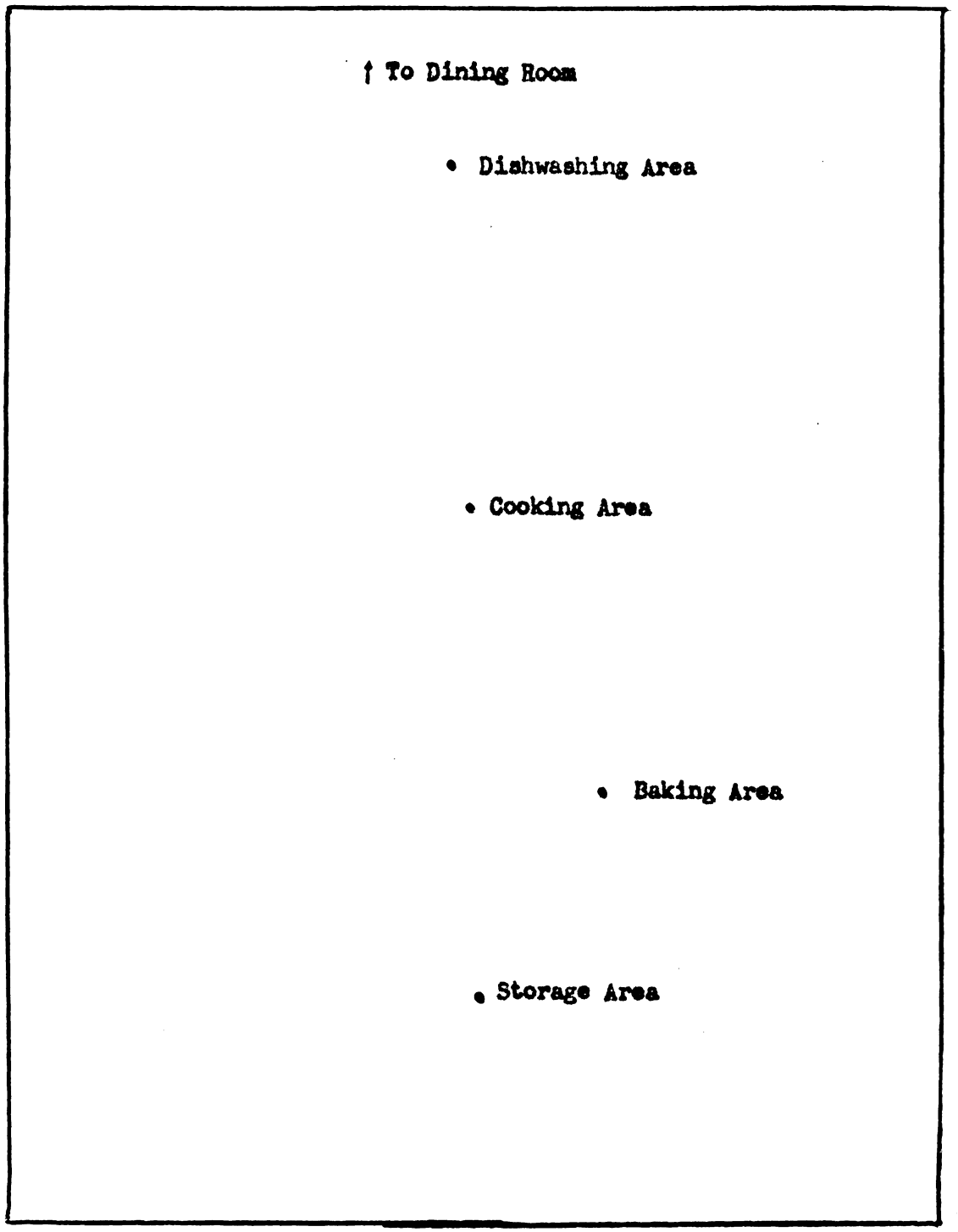
Chart 2 on page 34 shows the average location of the center of each kitchen work area as reported in this study. Sixteen of the colleges reported that work areas were convenient to the dining room; eight reported work areas fairly convenient, and nine others either reported work areas inconvenient or did not comment. From this report, it can be seen that the majority of colleges used in this study are fairly well satisfied with the convenience of the kitchen as related to the dining room. However, the average work areas tend to be placed one right behind the other and lined up across the kitchen. The dishwashing area is nearest the dining room; the cookery is second from the dining room; the baking area is third; and the storage is nearest the rear exit.

Chart 3 on page 35 shows a suggested arrangement of kitchen work areas in relation to location of the dining room, making slight alterations on the average kitchen analyzed in this study. This chart has been prepared after study of kitchen lay-outs obtained that showed the most efficient service.

From analysis of data collected in this study it was found that:

(1) The number of meals served was directly related to the number of employees.

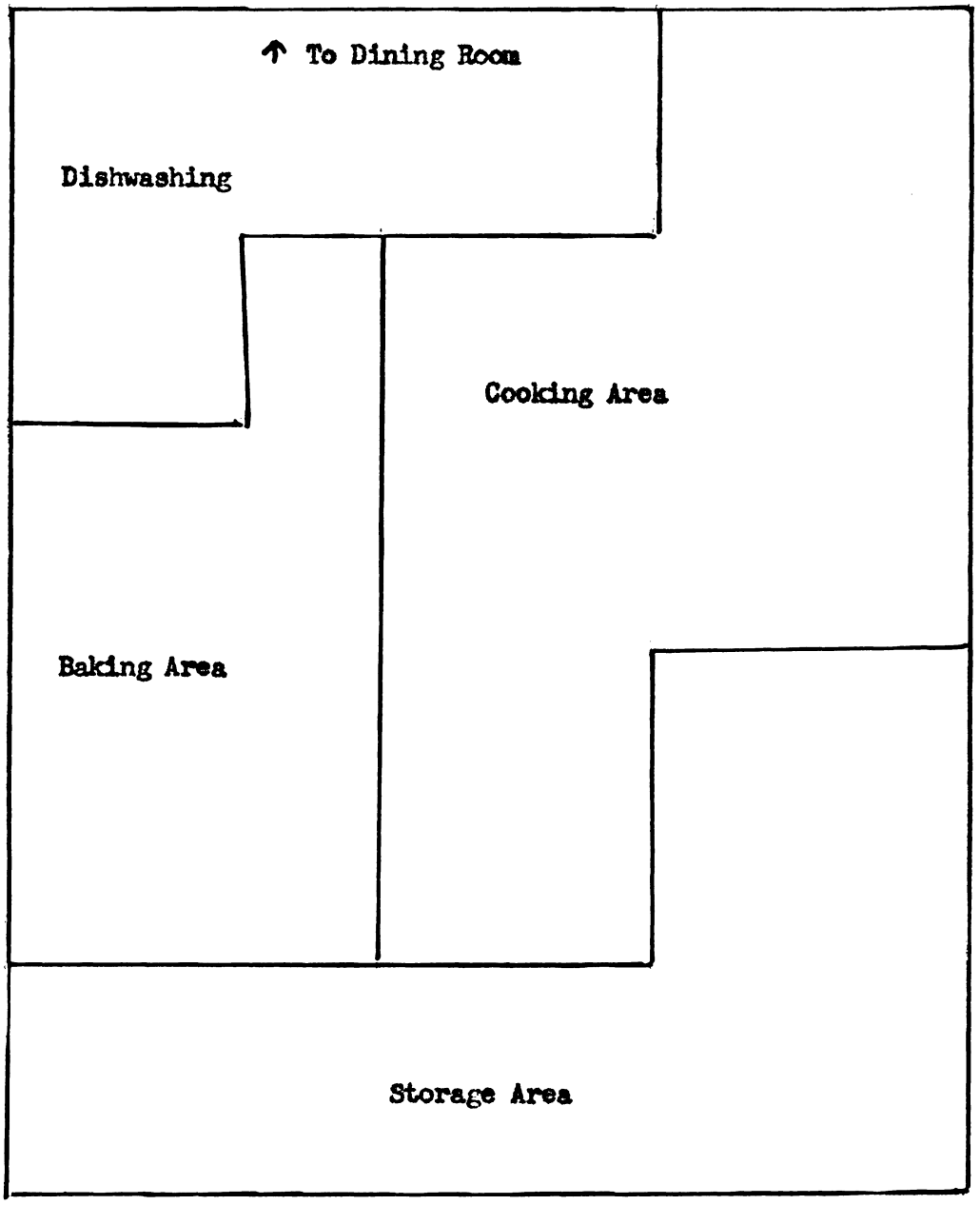
(2) The number of meals served per waiter was related to the type



Relative Position of Average Centers of Work Areas for

Fourteen College Kitchens

Chart 2



Recommended Relative Positions of Work Areas

for Efficient Food Production

Chart 3

of table service used, Cafeteria Style Service being the most efficient; the number of meals served per kitchen employee showed little or no relation to the type of table service used; and the number of meals served per total employee was slightly related to the kind of table service used. Cafeteria Style Service tended to be more efficient than Family Style Service.

(3) Education of the employees was negatively associated with kitchen efficiency.

(4) Compensation received by the employees was not related to work efficiency.

(5) Dietitian's salary was not significantly related to kitchen efficiency.

(6) The total number of labor saving devices used was related to kitchen efficiency; the number of ranges used was related to kitchen efficiency, but the number of dishwashers used was not related to kitchen efficiency.

(7) There was no relation of kitchen color to kitchen efficiency.

(8) The size of the work areas showed no relation to kitchen efficiency.

(9) The different work areas, such as the cooking area, baking area, dishwashing area, and storage area tended to be located in or near the same place in each college kitchen; the dish-

washing area was nearest the dining room, the cooking, baking, and storage areas were in line, respectively, across the kitchen.

(10) Most of the colleges considered their kitchens convenient.

Chapter IV

Summary and Conclusions

The purpose of this investigation was to determine the factors that might affect efficiency of food production in college feeding. This study, conducted in the fall and winter of 1950-1951, included thirty-three colleges enrolling twelve hundred students or less. All data used were obtained from schedules especially planned for this study by the writer and executed by the college dietitians.

From analysis of the data thus collected it was found that:

(1) The number of employees was directly related to the number of meals served.

(2) The number of meals served per waiter was related to the type of table service used; the number of meals served per kitchen employee showed little or no relation to the type of table service used; and efficiency in the number of meals served per total employee was slightly more related to Cafeteria Style Service than to Family Style Service.

(3) Education of the employees was not associated with kitchen efficiency.

(4) Compensation received by the employee was not related to the work efficiency.

(5) Dietitian's salary was not significantly related to kitchen efficiency.

(6) The total number of labor saving devices used was related to kitchen efficiency; the number of ranges used was related to kitchen efficiency, but the number of dishwashers used was not related to kitchen efficiency.

(7) There was no relation of kitchen color to kitchen efficiency.

(8) The size of the work areas showed no relation to work efficiency.

(9) The different work areas such as the cooking area, baking area, dishwashing area, and storage area tended to be located in or near the same place in each college kitchen; the dishwashing area was nearest the dining room, the cooking, baking, and storage areas were in line, respectively, across the kitchen.

(10) Most of the colleges considered their kitchens convenient, but slight alterations in arrangement of work areas would, in most cases, increase efficiency of operation.

Conclusions

This study shows that there is no stereotyped arrangement of work areas in the various kitchens, but college kitchens tend to arrange all the work areas in line across the middle of the kitchen, with dishwashing area nearest the dining room, cooking area second, baking area third, and storage nearest the rear exit.

Efficiency in college kitchens could be increased by (1) Cafeteria Style Service (2) use of more labor saving devices, and (3) better arrangement of kitchen work areas.

Recommendations

On the basis of the findings of this study the following recommendations are made:

(1) There is a need for further study to determine (a) the best possible arrangement of work areas in relation to each other in institution kitchens, and (b) the best size of each work area in relation to the number of employees working in that particular area.

(2) If efficiency of food production is related to the number of meals served per employee per day, better and more adaptable training for dietitians and other employees would increase the efficiency of food production.

(3) If the number of labor saving devices is significantly related to kitchen efficiency, until better pre-service and in-service training are available to dietitians and other kitchen employees for more efficient food production, labor saving devices rather than employees should be increased whenever possible.

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Acknowledgment of indebtedness is due to all of those who made this investigation possible.

S. S.

Appendix

Colleges and Universities Used in This Study

Alabama:	
Alabama College, Montevallo	819
Alabama State Teachers College, Troy	951
Judson College, Marion	225
Arkansas:	
Arkansas State Teachers College, Conway	1200
Florida:	
Barry College, Miami 38	265
Georgia:	
Bessie Tift College, Forsyth	245
Georgia State Woman's College, Valdosta	367
Georgia Teachers College, Collegeboro	756
Wesleyan College, Macon	619
Kentucky:	
Asbury College, Wilmore	1052
Mississippi:	
Belhaven College, Jackson 4	289
Mississippi State College for Women, Columbus	1153
North Carolina:	
Greensboro College, Greensboro	369
Guilford College, Guilford, N. C.	640
Meredith College, Raleigh	625
Western Carolina Teachers College, Cullowhee	590
Ohio:	
Antioch College, Yellow Spring	1121
Capital University, Columbus	1129
Lake Erie College, Painesville	207
Muskingum College, New Concord	915
Oklahoma:	
Oklahoma College for Women, Chickasha	722
Phillips University, Enid	1200
Tennessee:	
Carson-Newman College, Jefferson City	750
Scarritt College, Nashville 4	229
Southwestern College at Memphis, Memphis 12	820
Tennessee State College (East), Johnson City	1094
Middle Tennessee State College, Murfreesboro	1012
Tusculum College, Greenville	425

Virginia:	
Bridgewater College, Bridgewater	529
Lynchburg College, Lynchburg	732
Radford College, Radford	787
Longwood College, Farmville	775
West Virginia:	
Concord College, Athens	1108

VIRGINIA POLYTECHNIC INSTITUTE

Department of Home Economics

Blacksburg, Virginia

November 20, 1950

In making a study of college food service in connection with the Home Economics Department at Virginia Polytechnic Institute, certain first hand data needs to be collected. We would like to include your institution in this survey, and we would greatly appreciate your cooperation in filling out the enclosed questionnaire. Please return it to me in the enclosed self-addressed envelope not later than December 15, 1950.

The results of this study will be available upon request.

Thank you for your cooperation in making this study possible.

Sincerely yours,

Sallie Scott

SS:nw
Enclosure

VIRGINIA POLYTECHNIC INSTITUTE

Department of Home Economics

Blacksburg, Virginia

February 17, 1951

In making a study of college food service in connection with the Home Economics Department at Virginia Polytechnic Institute, certain first hand data needs to be collected. We would like to include your institution in this survey, and we would greatly appreciate your cooperation in filling out the enclosed questionnaire. Please return it to me in the enclosed self-addressed envelope not later than March 1, 1951.

The results of this study will be available upon request.

Thank you for your cooperation in making this study possible.

Sincerely yours,

Sallie Scott

SS:nw
Enclosure

COLLEGE FOOD SERVICE SURVEY

Name of School _____

Type of Food Service _____

Number of people served per meal:

Breakfast _____ Lunch _____ Dinner _____

Men _____ Women _____ Both _____

Size of Dining Room _____

Number of Employees:

White: Male _____ Female _____

Colored: Male _____ Female _____

Number of Waiters _____ Waitresses _____ Bushboys _____

Signed _____

Title _____

EMPLOYEE BREAKDOWN

Job	Education	Special Training	Wages	Hours	Duties
Dietitians					
Cooks 1.					
2.					
3.					
4.					
Baker 1.					
2.					
3.					
4.					
Pantry help 1.					
2.					
3.					
4.					
Dishwashers 1.					
2.					
3.					
4.					

Equipment	Name	No. Used	Fuel	Size	Ade-quate	Effi-cient	Recommendations
Ranges, ovens, etc. Ranges Ovens Toaster							
Steam Kettles, etc. Compartment Steamer Steam Jacketed Kettle Pressure Cooker Deep Fat Fryer Others							
Kitchen Machines Mixers Peelers Meat Slicer Food Cutter Others							
Sinks Compartment Sinks Vegetable Sink Cook's Sink Pot Sink Hand Sink Mop Sink							
Dish Machine Silver Machine							
Refrigerators Refrigerators Ice Cream Cabinet Frozen Food Cabinet							

CHECK SHEET FOR KITCHEN EFFICIENCY

Instructions: In each group, check statements applying to your situation.

I. Work Area

A. Location
1. Inconvenient
   a. Not near outside entrance
   b. Food prepared far from serving room
2. Fairly Convenient
   a. Near outside entrance for deliveries
   b. Food prepared near serving room
3. Convenient
   a. Has outside entrance for deliveries
   b. Food preparation and serving areas adjacent

B. Size
1. Badly crowded
   a. Insufficient work space
   b. Not large enough for necessary equipment
   c. Workers continually get in each other's way
2. Crowded part of the time
   a. Not enough work space for some activities and for some desirable equipment
   b. Workers at times get in each other's way
3. Large enough for all activities and for appropriate equipment Workers can perform duties without interference.

C. Lighting
1. Dim or glaring; artificial lights too few or placed poorly
2. Little glare; sufficient light in some areas but difficult to regulate
3. No glare; all areas well lighted and easily regulated No shadows on work surfaces

D. Ventilation
1. Stale, musty, or odorous; damp or drafty
2. Usually fresh, occasionally odorous; some condensation
3. Fresh and free from odors or condensation

E. Heating
1. Too hot in summer; too cold in winter
2. Comfortable during some seasons, but difficult to regulate
3. Comfortable at all times; easily regulated

F. Walls and Ceiling
   1. Dirty or dingy; cracked plaster or torn paper or very shiny surface
   2. Clean; in good repair but unattractive in design and color
   3. Clean; in excellent repair; colorful; attractive in design
   Colors used are:

G. Work surfaces
   1. Easily marred; difficult to clean; too small; height not adjusted to workers; provide for no expansion (drop leaves or pull-outs)
   2. Durable; usually adequate in size but not continuous; Fairly easy to clean; provide for some expansion
   3. Adequate in size; continuous; conveniently located; easy to clean; durable; provide for considerable expansion
   Materials used on surfaces are:

H. Built-in equipment
   1. Poorly arranged for efficient work
   2. Well arranged in relation to some work centers
   3. Well arranged im relation to all work centers

I. Permanent equipment
   1. Make-shift
      a. Too limited for effective work
      b. Unsuitable for use
      c. In need of repair
      d. Difficult to clean
   2. Some pieces suitable but additional pieces needed
      a. Some in need of repair
      b. Fairly difficult to clean
   3. Types suitable
      a. Size and amount adequate
      b. All in excellent condition
      c. Easy to clean

J. Small equipment
   1. Very inadequate in kind and amount
      a. Dishes and utensils badly chipped
      b. Difficult to clean
   2. Sufficient number of most articles
      a. In fair condition
      b. A miscellaneous assortment of china, glass and silver
      c. Easy to clean, attractive

II. Storage Facilities for Food

A. Space
   1. Inadequate in size and type
      a. Poorly located in relation to use
      b. Unventilated, not lighted

A. Space (continued)
   2. Adequate for some types of foods
      a. Fairly well located
      b. Some ventilation
      c. Lighted in some areas
   3. Satisfactory to care for all food storage needs
      a. Well located
      b. Well ventilated
      c. Well lighted

B. Refrigeration
   1. Too small to care for all perishable supplies
      Not cold enough (about 50°)
   2. Large enough to care for all perishable food
      Maintains temperature below 50°

III. Sanitary Conditions

A. Plumbing
   1. Often out of order; danger of contaminating food or equipment by sewage
   2. Occasionally out of order
   3. Properly installed and in good repair; food and equipment protected from contamination

B. Garbage disposal
   1. Uncovered, leaky containers too small for needs; not emptied regularly or kept clean
   2. Poorly covered containers, fairly adequate in size; emptied 2 or 3 times a week; cleaned occasionally
   3. Water-tight, insect and rodent proof containers; large enough; tight-fitting lids; emptied daily and kept clean
   4. Garbage disposal unit

C. Protection against pests
   1. No screens; evidence that insects or rodents have contaminated food; food spilled and not cleaned up
   2. Some windows screened but screens in need of repair; some evidence of insects or rodents but food protected; some areas clean but not all
   3. Screens at all windows and doors in good condition; no evidence of insects or rodents; immaculately clean.

D. Hand-washing and toilet facilities for workers
   1. Inadequate, unsanitary, inconvenient; common hand towels used
   2. Crowded; poorly equipped, lighted or ventilated; fairly convenient; paper towels but no place to dispose of them
   3. Well equipped and well kept; clean individual or roller towels, or paper towels with place for disposal nearby

Sketch layout on attached sheet.

Defining Probability

When calculating the probability that the association between the qualities or the instances of the degrees of qualities of two or more factors may or may not be due to chance alone, the method of X^2 or the sum of relative differences is used. In doing this it is necessary to compare the actual frequencies of the degrees of the factors with the distribution expected to be found if the factors were independent and unrelated.

After the observed values are inserted in a table, the first step is to find the independence value for each cell. In the example these values represent the number of meals served per waiter in each of the three types of food service which one would expect to find in the colleges.

For example the actual number of colleges using cafeteria service in the sample of thirty-three was four. If there is no association between type of service and the number served per waiter, one should expect to find $\frac{13 \times 18}{33}$ or 7.09 schools using cafeteria service serving up to fifty meals per waiter. The "independence" values are found for each cell by multiplying together the totals of the row and column in which the cell lies and dividing the product by the total number of instances.

When the "independence" values have been calculated for each cell, the next step is to find the difference (d in table) between the (obs) actual value and independence values (m). Each particular

difference (d) is then squared (d^2 in table) and the square is divided by each particular independent value (d^2 divided by m). These quotients are called the relative difference. The sum of the relative difference is called X^2.

The probability that X^2 in the sample table (12.85 for a 4 X 3 table) could be due to chance alone is less than (<) .05. This means that there are five chances in one hundred that the association could be due to chance alone. For X^2 to be significant the probability must be less than (<) .05.

RELATIONSHIP OF TYPE OF SERVICE TO THE NUMBER OF MEALS PER WAITER

Number Meals Per Waiter	Cafeteria	Cafeteria Family	Family	Totals
0-50	obs. 4 m 7.0909 d_2 3.0909 d^2 9.5536 rd 1.3473	obs. 3 m 2.7272 d_2 .2728 d^2 .7441 rd .2728	obs. 11 m 4.0909 d_2 6.9091 d^2 4.7735 rd 1.1668	18
51-100	obs. 4 m 3.1515 d_2 .8485 d^2 .7199 rd .2284	obs. 0 m 1.2121 d_2 1.2121 d^2 1.4691 rd 1.2120	obs. 4 m 3.6363 d_2 .3637 d^2 .1322 rd .0363	8
101-150	obs. 4 m 1.9696 d_2 2.0304 d^2 4.8424 rd 2.4585	obs. 1 m .7575 d_2 .2425 d^2 .5880 rd .7762	obs. 0 m 2.2727 d_2 2.2727 d^2 5.1651 rd 2.2726	5
151-200	obs. 1 m .7878 d_2 .2122 d^2 .4502 rd .5714	obs. 1 m .3030 d_2 .6970 d^2 .4858 rd 1.6033	obs. 0 m .9090 d_2 .9090 d^2 .8262 rd .9089	2
Totals	13	5	15	33

$$X^2 = 12.8545$$

$$P < .05$$

Education Key

1. Grade 1 -4
2. Grade 4.1-8
3. Grade 8.1-2nd. year high
4. High school graduate
5. One or two years college
6. Three or four years college