A BASIS FOR COURSE CONTENT IN RURAL ELECTRIFICATION FOR THE PREPARATION OF VOCATIONAL AGRICULTURAL TEACHERS IN MICHIGAN

Thesis for the Degree of Ed. D.

MICHIGAN STATE UNIVERSITY

Samuel H. K. Shih

1962

This is to certify that the

thesis entitled

A BASIS FOR COURSE CONTENT IN RURAL ELECTRIFICATION FOR THE PREPARATION OF VOCATIONAL AGRICULTURAL TEACHERS IN MICHIGAN

presented by

SAMUEL H. K. SHIH

has been accepted towards fulfillment of the requirements for

Doctor degree in Education

Raymond M. Clark
Major professor

Date May 14, 1962

O-169

A BASIS FOR COURSE CONTENT IN RURAL ELECTRIFICATION FOR THE PREPARATION OF VOCATIONAL AGRICULTURAL TEACHERS IN MICHIGAN

By

SAMUEL H. K. SHIH

AN ABSTRACT OF A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF EDUCATION

College of Education

1962

ABSTRACT

Purpose.--To find a basis for course content in rural electrification for the pre-service and in-service training of Michigan teachers of agriculture.

Method.--Agricultural engineers, leaders in teacher education, prospective teachers and young farmers collaborated in preparing the check-list with 49 abilities divided into six sub-areas.

The check-list was rated by seven groups: Leaders in teacher education, teachers of agriculture, prospective teachers, agricultural engineers, rural servicemen, farmer members of advisory councils and young farmers. The course content for pre-service training of teachers was based on the composite rating of the seven groups.

The 47 teachers of agriculture rated the adequacy of training and frequency of teaching of the 49 abilities in their high schools. The teachers' ratings were compared and evaluated with the composite ratings of the seven groups. The recommendation for course content for in-service training was based on the comparisons and evaluations.

Findings and interpretations.--(1) The differences in the degree of importance of the 49 abilities are significant. (2) Most of the abilities relating to safety were in the first degree of importance, while four of the five abilities relating to heating and cooling were in the fourth

and least degrees of importance.) (3) According to the ratings of the seven groups, the rank order of the six sub-areas is: safety, wiring, motors, lighting, basic abilities, heating and cooling. (4) The four groups of respondents who were related to the profession of teaching (leaders in teacher education, teachers of agriculture, prospective teachers and agricultural engineers) rated the 49 abilities more important than did the rural servicemen, farmer members of advisory councils and young farmers. ((5) A pooled opinion of the seven groups is more representative than any one group concerned. (6) The abilities within each of the six sub-areas are in different degrees of importance. (7) Difference between abilities is sometimes more discriminating than between the sub-areas. (8) All the abilities in the sub-areas of wiring, motors, lighting, and safety were rated important enough to warrant inclusion in the course content for in-service training. (9) The training score was rated significantly lower than the importance score, therefore, the training was not adequate, and in-service training is needed. (10) Except for a few abilities related to safety, the teachers reported that the training in most of the abilities was in proportion to importance. Similarly, the frequency of teaching each of the 49 abilities was directly related to the ratings of importance and the adequacy of training in that ability. (11) There is significant positive correlation between the rank

order of the 49 abilities rated by the seven groups and the rank order of the 49 abilities of the three ratings (importance, training and frequency of teaching) by the 47 teachers.

Recommendations were made for course content for both pre-service and in-service training of Michigan teachers of agriculture. The findings in the present study may be used by other groups. For instance, the instructors of a short course in rural electrification, the teachers of agriculture who plan to teach electrical abilities to high school students or farmers, the rural servicemen, the rural electrification extension workers and educators, may use the ratings of the seven groups to select teaching materials.

The method of investigation for building the course content for pre-service and in-service training for teachers used in the present study may be adopted by other states and in other phases of farm mechanics.

A BASIS FOR COURSE CONTENT IN RURAL ELECTRIFICATION FOR THE PREPARATION OF VOCATIONAL AGRICULTURAL TEACHERS IN MICHIGAN

By

SAMUEL H. K. SHIH

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF EDUCATION

College of Education

1962

ACKNOWLEDGMENT

The author is deeply grateful for the assistance and advice provided by his graduate study guidance committee. The chairman of the committee, Dr. Raymond M. Clark, patiently advised and helped the writer in every way, especially in the preparation of the report. Genuine appreciation is expressed for the special assistance and suggestions given by the other members of the committee: Dr. Harold M. Byram, Professor Dennis E. Wiant and Dr. Harry W. Sundwall.

In a similar manner, indebtedness is expressed to members of the staffs in Agricultural Education and Agricultural Engineering at Michigan State University, together with Mr. Harry Nesman and other state consultants in Agricultural Education, selected Michigan teachers of vocational agriculture, farmer members of advisory councils, Michigan power suppliers and others who cooperated in furnishing the data in this study.

Special thanks is accorded to Dr. William D. Baten and Mr. John J. Paterson for their statistical help. Sincere gratitude is expressed to Miss Gladys Harger for her invaluable clerical assistance.

This thesis is dedicated to the author's guardians, Mr. and Mrs. Gustav A. Sell, and his wife, Mary M. Y. Shih. Their patience, understanding and encouragement has contributed so fundamentally towards the undertaking and completion of this study.

TABLE OF CONTENTS

Table of Contents

Table of Contents

LIST OF TABLES

List of Tables

List of Tables

LIST OF FIGURES

List of Figures

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

The major purpose of this study is to find a basis for course content in rural electrification for the preparation of teachers of vocational agriculture in Michigan. Two subsidiary purposes of the present study are to determine: (1) What abilities, in order of importance, are needed by Michigan teachers of agriculture for pre-service training? and (2) What abilities are needed by Michigan teachers of agriculture for in-service training?

The major phases of the problem presented in this chapter are in the following order: (1) background of this problem, (2) importance of the present study, (3) purpose of this study, (4) scope and limitation of this study, (5) basic assumptions, (6) research hypotheses, and (7) definition of terms used.

Background of This Problem

To analyze this problem, two topics will be reviewed: the development of rural electrification and the importance of rural electrification education.

The development of rural electrification

In 1900, the electrical industry was just beginning,

now 62 years later, it is one of the most important industries in the United States. The principal use of electricity in the early days was for lighting. The use of electricity on the farms was promoted by the Committee on the Relation of Electricity to Agriculture,[1] in 1923. Later the American Society of Agricultural Engineers, Rural Electrification Administration, Edison Electric Institute and National Rural Electric Cooperative Association cooperated to expand the rural electrification program. This program has developed at an unexpected rate.

More farms used electricity and more electricity was used on each farm.--Even the most ardent advocate of rural electrification did not, in the early days, foresee the phenomenal growth of the use of electricity in the rural regions of the United States. Brown stated:

> In 1934 only 10 per cent of the farms in the United States were served with electricity. By 1955, 91 per cent of the farms were receiving this service.[2]

From 1935 to 1959, according to the Rural Electrification Administration report,[3] the number of consumers increased more than five million in a period of 24 years. The

---

[1]Robert H. Brown, Farm Electrification (New York: McGraw-Hill Book Co., Inc., 1956), p. 1.

[2]Ibid.

[3]U. S. Department of Agriculture, Rural Electrification Administration Statistical Report, 1959, p. VII.

electric energy consumption and cost per farm from 1945 to 1959 is shown in Table 1. The amount of electricity used per farm was increasing, while the cost per kilowatt-hour was decreasing.[4]

Thus, the trend has been: (a) the amount of electricity used on each farm increased and (b) the cost per kilowatt-hour of electricity decreased.

TABLE 1.--Electric energy: consumption per farm and cost, 1945 to 1959, east of 100th meridian and west of 100th meridian

Year	Electric energy used per farm (kwhr)	Average cost per kwhr (cents)	Year	Electric energy used per farm (kwhr)	Average cost per kwhr (cents)
1945	1,461	3.73	1953	3,004	2.93
1947	1,802	3.41	1955	3,650	2.76
1949	2,169	3.26	1957	4,139	2.68
1951	2,639	3.08	1959	4,875	2.56

From U. S. Department of Agriculture, Agricultural Statistics, 1960, Table 808, p. 588. (Only a part of the data in Table 808 is used.)

What has this trend to do with the American farmers? How has it affected the lives of the farm people?

More electricity means more "hands."--We may better understand how electricity has brought profits and benefits

[4] Ibid., 1960, Table 808, p. 588.

to the American farmers by comparing the efficiency of "electrical energy" and "human energy." Brown[5] estimated that three cents worth of electricity would do each of the following operations:

Clean and grade 60 bu. of grain
Mix 2 cu. yd. of concrete
Shear 50 sheep
Milk 50 cows
Pick 100 chickens
Shell 100 bu. of corn

In 1947, even draft animals like buffaloes and oxen were not owned on every farm in Nanking, China. Almost all the chores were done by man power. Chinese farmers used their muscles or "rice power." In comparison with human energy and electric energy, Wright pointed out:

> Comparative costs of pumping water by hand and by an electrically driven pump indicate that a hired man, when paid a wage comparable to the "wage" we pay the motor on a pump, would earn about 10 cents in an eight-hour day.[6]

Thus, ten cents worth of "electrical energy" on a Michigan farm would equal "eight hours of human energy" on farms where electricity is not available. This may explain, at least partly, why an American farmer can produce more food than the farmer of other countries. Figuratively speaking, each farmer in China in 1947 had just two hands; while each

---

[5]Brown, op. cit., p. 5.

[6]Forrest B. Wright, Electricity in the Home and on the Farm (3rd edition; New York: John Wiley and Sons, Inc., 1950), p. 5.

farmer in Michigan now has about 100 "electrical hands."

These "electrical hands" are the electrical equipment used in an American home and farm. For instance, Brown[7] listed 62 home electrical appliances. They varied from electric blankets to electric water heaters. He also mentioned 61 items of farm electrical equipment. They varied from barn ventilator to wood saws. The kinds of electrical equipment used by the farmers have been constantly increasing over many years.

Reasons for fast development of rural electrification.--To sum up what has been stated: The cost of electricity has declined since the 1930's, while the cost of labor, land, machinery, gasoline and almost all other items of farm production have been rising during the same period. Naturally, farmers have taken advantage of using more electricity--to "hire" more "electrical hands" at the lowest cost. The production power of each farmer, and the convenience of each farm family has been directly proportional to the amount of electricity they have used. This is why electricity consumption per farm was increased as shown in Table 1. Is it any wonder that both the farmers and the power suppliers have had great interest in developing the rural electrification program?

---

[7]Brown, op. cit., pp. 24-25.

Development of rural electrification program in Michigan

On February 4, 1927, Michigan State College in cooperation with the Consumers Power Company, planned the first rural electrical line in Michigan between Mason and Dansville, and Michigan became one of the pioneer states in developing the rural electrification program. Along the seven-mile line, only 12 out of the total of 33 farms were willing to cooperate by wiring their buildings; the others rejected the opportunity to take part in the project.[8] However, the development of rural electrification in Michigan since then has been very rapid.

Michigan had the highest percentage of farms on power lines.--By 1959, Michigan had 98.6 per cent of farms receiving central station electric service.[9] Michigan had the highest percentage of farms with electricity in the five North East Central states. The average percentage of farms electrified in the North East Central region of the United States was 97.9. This was the highest among the 10 regions in America. The national average was 96 per cent.

---

[8] Michigan Consumers Power Company, How Electricity Came to 100,000 Michigan Farm Customers of Consumers Power Company, Special Bulletin (Jackson, Michigan: Consumers Power Co., 1949), p. 5.

[9] U. S. Department of Agriculture: Agricultural Statistics, 1960, Table 809, p. 589.

Michigan farms used more electricity and cost became less.--In 1930, an annual average of 721 kilowatt-hours of electricity was used by the farms served by the Michigan Consumers Power Company.[10] In 1945, the amount increased to 2,137 kilowatt-hours. This represents nearly 300 per cent increase within a 15-year period. The cost per kilowatt-hour of electricity decreased from 4.51 cents in 1930 to 2.55 cents in 1945. The cost in 1945 was less than 57 per cent of the cost 15 years before. With the great demand for and interest in rural electrification by farm people, the problem of educating farmers to use more electricity and to use it adequately has become the responsibility of the educators. Since vocational agriculture teachers ought to meet the growing educational needs of farmers, the problem of preparing teachers in the field of rural electrification has become important.

The development of rural electrification education both in the United States and in Michigan is to be discussed in the following section.

Importance of rural electrification education

The need of teaching farmers to use electricity adequately has been expressed by the teachers of agriculture, leaders in teacher education and many other groups both in

---

[10]Michigan Consumers Power Company, op. cit., p. 8.

the nation and in Michigan. They all agree that teachers of agriculture should be prepared in the field of rural electrification so as to teach and help the farmers.

Development of rural electrification education in the United States.--Many teachers of agriculture, leaders in teacher education and agricultural engineers over the United States have pointed out the challenge to teachers of agriculture. For instance, H. L. Price, a vocational agriculture teacher, stated:

> The coming of the REA offers a direct challenge to teachers of agriculture. We know that most of our farm youth are practically in ignorance of the principles of electricity. . . . The need for training along these lines is probably more urgent than ever in our farm mechanics course.[11]

Walker[12] and London[13] said that the job of electrifying the rural home and farmstead has never been completely solved. They expressed the opinion that the crux of the matter seemed to be the education of farm families themselves in the use of electricity.

In his survey of 44 farms in Texas, Birdwell[14]

---

[11] H. L. Price, "Planning Instruction on Rural Electrification," The Agricultural Education Magazine (June, 1940) 12:235.

[12] Clyde Walker, "Rural Electrification in Vocational Agriculture," The Agricultural Education Magazine (July, 1939) 12:12.

[13] H. H. London, "Education, the Key to Improved Use of Electricity on the Farm," The Agricultural Education Magazine (April, 1948), 20:196.

[14] Raymond S. Birdwell, "A Study of the Use of Electricity by Farmers in the Sherman Community, Texas." (Non-thesis Study, Agricultural and Mechanical College of Texas, College Station, Texas, 1952), p. 15.

concluded that farmers were not using all the electrical equipment that might be profitably used on their farms. The farmers were not aware of many ways they could use electrical equipment profitably. He also revealed the inadequate or overloaded wiring system. The majority of the farms he surveyed needed rewiring. Birdwell[15] concluded that the lack of knowledge and skill in electricity was the main cause of farmers not using it.

Sneep[16] and Ryder[17] reported the need among Ohio teachers of agriculture for training in the area of rural electrification. Ryder found that the problems in farm electrification which were of the greatest concern to the farmers were the ones which the teachers considered themselves least prepared to teach.

The need for further training in rural electrification was indicated in Stuckey's study.[18] He found that 67

---

[15] Ibid., pp. 16-17.

[16] Neil Owen Sneep, "Improving the Teaching of Farm Electrification in Vocational Agriculture in Ohio." (Master's thesis, The Ohio State University, Columbus, Ohio, 1957), p. 130.

[17] Gorden I. Ryder, "Preparation in Farm Mechanics Education for Teachers of Vocational Agriculture." (Doctor's thesis, The Ohio State University, Columbus, Ohio, 1954), p. 134.

[18] Wenrick E. Stuckey, "The Present Program and Needs for In-service Education in Farm Mechanics for Teachers of Vocational Agriculture in Ohio." (Non-thesis study, The Ohio State University, Columbus, Ohio, 1956), p. 22.

per cent of the teachers he questioned had attended workshops on electricity. Sneep reported that teachers in his study ranked electrical workshops at the top of all past in-service education.

Rural electrification became an integral part of the farm mechanics program.--The preceding paragraphs have pointed out the need to prepare the teachers of agriculture in the field of rural electrification. Leaders in teacher education and agricultural engineers have suggested that farm electrification be included in farm mechanics training for teachers of agriculture. This was stated by Cook, Scranton and McColly:

> The present and future farmers should be trained in the knowledge, skills, ideals . . . that are needed to meet the mechanical problems. . . .
> If a plan of instruction in farm mechanics meets the needs of the farmers, it must contain . . . farm electrification.[19]

The subcommittee on Agricultural Teacher Training of the American Society of Agricultural Engineers, in collaboration with an Advisory Group of Agricultural Education specialists recommended in their report of June 22, 1944, the following five areas of instruction in farm mechanics:

1. Farm shop work

2. Farm power and machinery

---

[19] G. C. Cook, L. L. Scranton and H. F. McColly, Farm Mechanics Text and Handbook (Danville, Illinois: The Interstate, 1946), p. 32.

3. Farm buildings and conveniences

4. Soil and water management

5. Rural electrification[20]

Again in 1953, the Committee on Agricultural Teacher Training, College Division of the society mentioned above and the specialists of the same group recommended rural electrification as one of the five "Agricultural Engineering Phases of Teacher Training for Vocational Agriculture."[21]

To sum up, farmers need training in rural electrification if they are to use electricity efficiently. Teachers of agriculture must meet the challenge to teach the farmers. Leaders in teacher education and agricultural engineers included rural electrification as one phase of farm mechanics training for teachers of vocational agriculture.

Rural Electrification Education in Michigan

Space is limited for the present study to describe all aspects of rural electrification education in Michigan. Only a few phases with implications to this study will be

---

[20] "Agricultural Engineering Phases of Teacher Training for Vocational Agriculture," A Report of the Subcommittee on Agricultural Teacher Training, Committee on Curriculum (College Division), American Society of Agricultural Engineers, in Collaboration with an Advisory Group of Agricultural Education Specialists, June 22, 1944 (Washington, D. C.: American Society of Agricultural Engineers, 1944).

[21] Committee on Agricultural Teacher Training, similar as cited in Footnote 20, only in 1953.

mentioned:

Regular courses at Michigan State University.--The following courses have been offered at the Agricultural Engineering Department of Michigan State University. Only those courses for preparation of teachers of agriculture, and short courses for farmers are listed: (1) For teachers of vocational agriculture--A.E. 412. This is the only course in rural electrification specially designed for prospective teachers of agriculture. It was a required course until 1959; since then it has been an elective. (2) For young farmers--A.E. 7. It is specially designed for the young farmers enrolled in the Short Course to study rural electrification.

Cooperative Extension Service.--Extension specialists from the Agricultural Engineering Department have taught farmer groups, the teachers of agriculture and county agents in non-credit meetings. It has been a kind of in-service training for some teachers of agriculture.

Michigan Committee on Rural Electrification.--This committee, in cooperation with Michigan State University, has produced nearly 200 copies of films or kinescope recordings. The "Electricity at Work" series of films have been widely used in classrooms, television showings and for many other purposes.

In high schools.--The vocational agricultural teachers have promoted rural electrification education through: (1) Teaching students in vocational agricultural departments--

Instruction in the use of electricity on the farms has been given in many schools. (2) Teaching young and adult farmers--Many classes have been conducted for teaching farmers to use electricity.

Power companies.--Farm service advisors from the power suppliers have conducted educational programs for Michigan farmers.

The research work done by Byram, Cook and others related to rural electrification education in Michigan, will be presented in the next chapter. Suffice it to say that even though rural electrification education has developed very rapidly in the nation and in Michigan, much remains to be done. One of the basic problems is to formulate a course content in rural electrification to train Michigan teachers of agriculture. This is the purpose of the present study.

Importance of the Present Study

Inventory of abilities needed by farmers and teachers.--It has been shown that expansion in rural electrification and in related education has been the trend throughout the United States including Michigan. Much progress has been made by the state leaders in teacher education and agricultural engineers at Michigan State University in training the teachers of agriculture. However, overloaded wiring and unsafe electrical practices of the farmers emphasize the importance of studying those abilities the farmers and teachers need to learn.

Abilities on wiring are needed.--H. G. Walt, the late farm service advisor of the Consumers Power Company reported that "A great majority of the farms and homes in Michigan need rewiring. Inadequate wiring has been the bottleneck in the use of range, milk-cooler and many other items of equipment on the farms during the last five to ten years."[22]

In Table 2, Walt and White reported that about half of their farm calls (from 49 per cent to 68 per cent) were on wiring problems. This is the "bottleneck" to full utilization of electricity. It prevents farmers from using the lowest cost energy and getting the highest profits. It checks the growth of the electrical industry. Thus abilities on wiring are important.

Abilities on safety needed.--"How to protect motors?" "How to ground equipment?" have been often asked by teachers of agriculture and farmers in Michigan, according to the extension specialists in the Agricultural Engineering Department of Michigan State University.

In 1955, Shih[23] found that 34.2 per cent of 688 Iowa farms did not adequately have the frames of the washing machines grounded, and about 25 per cent of the 688 farms

---

[22]After visiting the farms around Lansing for two days in April, 1958, Mr. Walt sent the unpublished data in Table 2.

[23]Samuel H. K. Shih, "Physical Hazards to Safe Living on 688 Iowa Farms." (Master's thesis, Iowa State College, Ames, 1955), p. 105.

TABLE 2.--Number and percentage of farm calls in the district of Lansing, Michigan, 1955-1957

The farm service advisor who served the calls						
	Herman G. Walt			John C. White		
	No. of farm calls		Percentage of calls on wiring	No. of farm calls		Percentage of calls on wiring
Year	Total	On wiring		Total	On wiring	
1955	443	195	44%	577	462	80%
1956	489	262	54%	659	511	77.5%
1957	390	187	48%	577	262	45.4%
Total	1322	644	49%	1813	1235	68%

Report from the district of Lansing, Michigan, by Consumers Power Company.

ignored the safety practice "Burned out fuses should not be shorted with coin, wire or other metal." The farmers' ignorance of hazardous overloaded wiring has often been the cause of fire, electric shock and injuries. All these instances have indicated the need to determine the abilities needed by the farmers and the teachers. The farmers and teachers may need other abilities. An inventory of abilities they need to learn is important and will provide an indication as to content needed in courses to prepare teachers in this field.

Need to find specific abilities for course content for Michigan.--Rural electrification has been recognized as

one of the important areas of farm mechanics by the leaders in teacher education. The objectives and suggested procedures were outlined by the Committee on Agricultural Teacher Training in 1953.[24] This is a broad outline. It is not intended to indicate specific course content. Some local situations and needs would vary between communities and states. For example, Horne[25] reported that in Virginia, the rural electrification education in the preparation of teachers in 1951 was focused on wiring, light and water systems. Berry[26] of Texas in 1952 suggested that the course content for Texas teachers should emphasize safety, electric terms and cost.

The specific abilities or learning experiences in rural electrification needed by Michigan teachers of agriculture have not been adequately determined. This is the second reason for this study.

Need the opinions of all groups to determine a course content.--Even though Michigan leaders in teacher education

---

[24] Committee on Agricultural Teacher Training, op. cit., p. 3.

[25] T. J. Horne, "Participation of Power Suppliers in the Educational Program of Land-Grant Colleges." (Blacksburg: Virginia Polytechnic Institute, 1951), pp. 1-3.

[26] M. T. Berry, "Practices and Opinions of Teachers in Area VIII of Texas Concerning the Teaching of Rural Electrification." (Master's problem, Sam Houston, State Teachers College, Huntsville, Texas, 1952), pp. 33-34.

have recognized rural electrification as an integral part of the farm mechanics program, they may not all be agreed on the specific abilities to include in the course for the preparation of teachers. As will be discussed in Chapter II, the opinions of groups vary in this respect. How to select course content which is based on the opinions of all groups concerned seems to be better than a partial opinion of a few groups.

Evaluation of course content and adequacy of training necessary.--Byram and Wenrich[27] point out that one of the difficult tasks in vocational education is that of keeping instruction abreast of new development. It is possible for vocational courses to get out of date. Therefore, there is a constant need for evaluation and examination of the content and the adequacy of the training of the course A.E. 412 if the course is to be up to date and meet the current needs of teachers.

Purposes of the Present Study

The major purpose of this study is to find a basis for determining the course content in rural electrification for (a) the training of the prospective teachers, and (b) the in-service training of the teachers in the high schools

---

[27] H. M. Byram and R. C. Wenrich, Vocational Education and Practical Arts in the Community School (New York: The Macmillan Company, 1956), p. 337.

in Michigan. The specific purposes are:

1. To find the rank order of importance of (a) each of the 49 abilities, (b) each of the six sub-areas and (c) each of the abilities within each of the six sub-areas as rated by the 216 respondents.

2. To ascertain the degree of importance of each of the 49 abilities rated by the 216 respondents.

3. To determine the degree of agreement among the seven groups in their ratings on (a) the rank order of the six sub-areas and (b) the importance of the 49 abilities.

4. To investigate (a) the adequacy of training and (b) the frequency of teaching these 49 abilities as reported by the teachers, and to determine the degree of interrelationship of importance, training and application rated by the teachers.

5. To compare the ratings between the composite and the teachers so as to identify the needs of the teachers for further training in certain abilities.

6. To determine priority and the degree of emphasis on certain abilities that will be needed in the course content for the in-service training of Michigan teachers of agriculture.

7. To demonstrate a method of investigation on this problem.

The Scope and Limitations of the Present Study

The scope

Respondents.--Respondents in the present study are confined to seven groups: Leaders in teacher education, teachers of agriculture, prospective teachers of agriculture, agricultural engineers, rural servicemen, farmer members of advisory councils and young farmers.

Period and place.--The data for the present study were collected from March to June, 1959. All respondents were in Michigan. The content is limited to the 49 abilities in the check-list.

Limitations of the Present Study

1. Many teachers of agriculture graduated from Michigan State University five to eight years before the present study was made. It may not have been easy for each one of them to remember how adequately they were trained in each of the 49 abilities.

2. This study is limited to the degree to which the respondents are able to present the need of teachers.

3. This study is limited to the 49 selected abilities. The basis of selecting the 49 abilities is to be discussed in Chapter III. The selection cannot be perfect. Some abilities could be important and needed by teachers but may have been omitted.

4. The limitations inherent in a check-list type of survey in securing data are recognized in the present study. Owing to the fact that variation would occur in the interpretation of words by different respondents, this study is limited to the accuracy of the interpretation of definitions and/or wording of this check-list. For example, the word "ability" was defined on the check-list, but this could not guarantee that every respondent has accepted this definition as stated when checking the list.

5. The present study depends upon the opinions of the respondents at the time the investigation was conducted in 1959. Since the opinions of each person is subject to change with changing conditions, the opinion in 1959 may not remain consistent with future opinions.

6. The rating scores are relative measures only. In analysis of the data, "very important" was given two points, "fairly important" one point and "relatively unimportant" zero points. While each of the 216 respondents checked the importance of each ability, it depended upon whatever he considered "important" to be. Personal biases and/or errors of judgment may be reflected in the importance scores. Therefore, the rating scores and mean scores used in this study indicate a relative measure only.

Basic Assumptions

In the present study it is assumed that:

1. Abilities indicate adequate understanding and performance. The development of abilities in the trainees taking the course represent adequate achievement in the teaching.

2. Each of the seven groups could evaluate most of the essential needs of the teachers by checking the importance of each ability.

3. The teachers' needs for abilities should be one of the most important bases in their training in the field of rural electrification.

4. The survey method used in the present study is a valid approach to assess the needs of the teachers. That is, the opinions of the 216 respondents of the seven groups reflect most of the important needs of the teachers. Since these seven groups are closely associated with the various aspects of rural electrification education, a comparatively unbiased estimation of the needs should be represented by a composite opinion of the seven groups.

5. There is a need for instruction in rural electrification for the prospective teachers of agriculture at Michigan State University. There is also a need for in-service training for the teachers of agriculture in high schools. There is a need to investigate the content of the course A.E. 412 and to evaluate the adequacy of the training received by the experienced teachers.

6. The great majority of the teachers of agriculture

who have taken the rural electrification course as preparation for teaching, have sound opinions on the adequacy of the training they received at the university. It is also assumed that these teachers can remember whether or not they taught each ability in their high school classes.

Research Hypotheses

The present study is designed to test the following hypotheses:

1. The degree of importance of some of the 49 abilities rated by the 216 respondents varies greatly. That is, some abilities are significantly more important than the others, they are not of equal importance.

2. There is agreement among the seven groups in the rank order of importance of the six sub-areas.

3. The disagreement among the seven groups in their ratings of the total of 49 abilities is not significant.

4. There is interrelationship of importance, training and application rated by the 47 teachers of agriculture.

5. The differences among the four means rated by the composite and the teachers of agriculture are not significant.

6. There is relationship between the rank order of the 49 abilities as rated by the composite (or seven groups, 216 respondents) and the three ratings by the 47 teachers of agriculture.

Definition of Terms

Since words can be interpreted differently by various people, it is necessary to define them. Only those words or phrases which may be subject to the most variation in interpretation and which are essential in this study are defined here.

Ability.--The term "ability" as used in the present study, implies adequate understanding and performance. The power, capacity or competence to do a certain job is ability.

Adequacy of training.--This implies the degree or level of the training the teachers received at Michigan State University in their preparation to teach rural electrification in the local high schools. Three varying degrees of adequacy of training are used: (a) adequate, (b) fairly adequate, and (3) inadequate.

Importance.--Importance denotes the quality or fact of being important. It indicates the position or relative standing of each of the 49 abilities. The varying degrees of importance of each ability used in the present study are: (a) very important, (b) fairly important, and (c) relatively unimportant.

Rural Electrification or Farm Electrification.--These two terms have been used to designate a subject area in farm mechanics. Rural electrification is divided into six subareas in the present study.

Although the present study deals with the 49 abilities in rural electrification, it is understood that rural electrification covers a much greater scope.

Rural servicemen.--This is the group of respondents from the power suppliers such as Consumers Power Company and rural electrification co-operatives in Michigan.

Sub-area.--Sub-area designates a group of related subject abilities. In the present study, it is divided into six sub-areas.

CHAPTER II

REVIEW OF LITERATURE

The present study is mainly concerned with the selection of abilities for the course content of rural electrification needed for the preparation of teachers of agriculture. In the Summaries of Studies in Agricultural Education, up to the year 1960, rural electrification was classified under the heading "farm mechanics."

Due to the voluminous amount of research that has been done in farm mechanics, the review has been limited to those studies that relate directly to the present investigation. Only those studies in farm mechanics that would meet one of the following criteria have been reviewed: (1) relating to the preparation of teachers, and (2) relating to the course content of rural electrification.

Literature Related to the Preparation of Teachers in Farm Mechanics or Rural Electrification

The course content of these studies may be farm mechanics or rural electrification. Since the purpose of this review deals mainly with the methods of investigation rather than the findings, the selection of respondents to collect data as a basis for course content in teacher training will be emphasized.

Of the 35 studies reviewed, 26 of them dealt with farm mechanics and nine with rural electrification. According to the methods of selecting respondents, the literature reviewed is classified according to the number of groups as shown in Table 3.

In the farm mechanics studies, 16 out of 26, or 62 per cent, had one group of respondents. In rural electrification studies, 78 per cent of them had one group of respondents. Thus, the majority of the studies reviewed used one group of respondents.

The group "teachers of agriculture" was used most often as respondents. Nearly 70 per cent of the 35 studies used teachers' opinion. More than one third of them secured information from various groups of farmers.

To plan a course content of farm mechanics, Cook, Walker and Snowden[1] advocated: (1) community surveys, (2) planning course around the objectives of the instructional program, and (3) the opinions of five groups--farmer members of advisory councils, farmers, shop teachers, extension agents and other local people.

All but one of the 35 studies reviewed used community surveys in planning course content of farm mechanics or rural

---

[1]Glen C. Cook, Clyde Walker and O. L. Snowden, Practical Methods in Teaching Farm Mechanics (Danville, Illinois: The Interstate Printers and Publishers, 1952), Chapter VII.

TABLE 3.--The 35 studies related to preparation of teachers in farm mechanics or rural electrification with respect to selection of respondents, 1926-1959

No. of Groups	Respondents (Studies on Farm Mechanics)	No. of Studies
1	Teachers of agriculture	11
1	Farmers	2
1	Leaders in teacher education	2
1	Graduates from college	1
	Total studies with one-group of respondents	16
2	Teachers of agriculture, farmers	5
2	Leaders in teacher education and graduates from college	1
	Total studies with two groups of respondents	6
3	Teachers of agriculture, specialists and leaders in teacher education	1
	Specialists, leaders in teacher education, and seniors in college	1
	Total studies with three groups of respondents	2
4	Teachers of agriculture, specialists, leaders in teacher education and farmer members of advisory councils	1
4	Teachers of agriculture, farmers, specialists, and businessmen related to farm mechanics	1
	Total studies with four groups of respondents	2
	Total Studies on Farm Mechanics	26

TABLE 3--Continued

No. of Groups	Respondents (Studies on Rural Electrification)	No. of Studies
1	Teachers of agriculture	3
1	Farmers	3
1	Power suppliers	1
	Total studies with one group of respondents	7
2	State leaders in teacher education and power suppliers	1
2	Teachers and power suppliers	1
	Total studies with two groups of respondents	2
	Total Studies on Rural Electrification	9
Grand Total		35

From U. S. Office of Education, Research Committee of the Agricultural Education Section, Summaries of Studies in Agricultural Education, 1935-1960.

electrification for the preparation of teachers. Eight groups were used as respondents: farmer members of advisory councils, farmers, teachers of agriculture, leaders in teacher education, graduates from agricultural college, specialists as agricultural engineers, seniors or prospective teachers in college, and businessmen or industrial people such as power suppliers.

In the present study, seven of the eight groups

indicated above are used as respondents. The only group that is not included is "graduates from the college of agriculture." The reason for excluding this group is that the course A.E. 412 (rural electrification) has not been required of all students in the college of agriculture.

The following is an elaboration of Table 3, with respect to selection of respondents.

Studies on farm mechanics relating to teacher preparation

Studies with one group of respondents.--A digest of eight master's theses and three special studies made by Campbell,[2] Dougan,[3] Schafer,[4] Hutson,[5] Blackman,[6] Hutson,[7]

---

[2]Jesse Lee Campbell, "Universal Shop Problems for Vocational Agriculture," (Master's thesis, University of Missouri, Columbia, 1926), p. 114.

[3]Riley Shelton Dougan, "Farm Shop Skills and Abilities Needed and Acquired by Beginning Teachers of Vocational Agriculture in Ohio," (Master's thesis, Ohio State University, Columbus, 1951), p. 139.

[4]Wallace A. Schafer, "Teaching Units in Farm Mechanics for Courses of Study in Arizona Departments of Vocational Agriculture," (Master's thesis, University of Arizona, Tucson, 1951), p. 99.

[5]Denver B. Hutson, and G. F. Ekstrom, "A Study of the Training Needs for Prospective Teachers of Vocational Agriculture," (Non-thesis study, University of Missouri, Columbia, 1952), p. 20.

[6]Albert Ernest Blackman, "A Suggested Farm Mechanics Training Program for Prospective Teachers of Vocational Agriculture in Louisiana," (Master's thesis, Louisiana State University, Baton Rouge, 1954), p. 102.

[7]Denver B. Hutson, "Instruction in Farm Mechanics as Conducted by Teachers of Vocational Agriculture in Arkansas," (Non-thesis study, University of Arkansas, Fayetteville, 1955), p. 26.

Odell,[8] Larson,[9] Longhurst,[10] Carnie[11] and Watkins[12] in Missouri, Ohio, Arizona, Louisiana, Arkansas, West Virginia, South Dakota, Utah and Idaho from 1926 to 1959 revealed the following essential points:

(1) Each of the 11 studies used teachers of agriculture as the only group of respondents. Some studies secured information from experienced teachers, (about five years' teaching) some studies collected data from both experienced and beginning teachers. Most of the studies selected teachers to serve as respondents, a few studies used the opinions of all the teachers in the respective states.

---

[8]Finley Odell, "The Farm Mechanics Skills Used by Vocational Agriculture Teachers in 40 Vocational Agriculture Departments in West Virginia," (Master's thesis, West Virginia University, Morgantown, 1955), p. 100.

[9]Marvin E. Larson, "A Study to Determine the Technical Abilities Needed in the Farm Mechanics Curriculum of Agricultural Education Majors in Pre-Service Training," (Master's thesis, South Dakota State College, Brookings, 1959), p. 165.

[10]Robert M. Longhurst, "A Study of the Farm Mechanics' Curriculum with Recommendations for the Teacher Training Institutions." (Seminar report, Utah State University of Agriculture and Applied Science, Logan, 1959), p. 35.

[11]George Major Carnie, "Evaluation of the Preservice Training of Vocational Agriculture Instructors in Farm Mechanics," (Master's thesis, University of Idaho, Moscow, 1959), p. 51.

[12]John Wendell Watkins, "Farm Mechanics Program and Facilities for Vocational Agriculture in Ohio," (Master's thesis, The Ohio State University, Columbus, 1959), p. 91.

(2) The purposes of these studies were:

(a) To determine the farm mechanics abilities needed by the teachers of agriculture.

(b) To bring about need for continuous re-evaluation of farm mechanics curriculum for teacher preparation.

(3) The questionnaire method was used by 10 of the 11 studies. Only Longhurst used literature review entirely to determine the course content. The interview method was supplemented with a check-list in Odell's investigation.

(4) The number of abilities or jobs or the items varied.

The present study selected experienced teachers as respondents.

Chilen,[13] Cook and Byram[14] asked farmer groups only to determine their needs for training in mechanical activities as a basis for curriculum building in farm mechanics for teacher education. Chilen selected 74 veterans to check 120

---

[13] Paul R. Chilen, "Farm Operator Evaluations of the Farm Mechanics Phases of Agricultural Engineering as Offered in the Department of Agricultural Engineering at Texas College of Arts and Industries, Kingsville, Texas," (Master's Report, Kansas State College, Manhattan, 1952), p. 70.

[14] Glen C. Cook and Harold M. Byram, "Mechanical Activities of Selected Farmers in Michigan," (Non-thesis Study, Michigan State College, East Lansing, 1952), p. 135.

skills. Cook and Byram had 676 fathers of boys enrolled in vocational agriculture in selected schools to evaluate 124 activities.

The present study is similar to Cook and Byram's study in that the list of abilities was prepared covering the areas of farm mechanics recommended by the committee of the American Society of Agricultural Engineers. The difference is that the present study covers only the area of rural electrification.

Dickinson[15] asked 65 teacher-trainers and supervisors from 44 states to supply information for course content. Longhurst[16] used the opinions of the leaders of teacher education by reviewing the writings of 48 outstanding men in the field of agricultural education.

The study of Jacobs[17] was unique in that he used the graduates of the college of agriculture as respondents.

Studies with two groups of respondents.--Five studies in which teachers and farmers were used as respondents have

---

[15]Sherman Dickinson, "A Survey of Instruction in Farm Shop," (Special Study, University of Missouri, Columbia, 1932), Agricultural Education Magazine, 4:170.

[16]Longhurst, op. cit.

[17]Clinton Otto Jacobs, "Determine the Need for a Program of Instruction in Farm Mechanics for College Students Based Upon a Survey of Farm-Operator Performance," (Master's thesis, Kansas State College, Manhattan, 1953), p. 77.

been reviewed. The earlier studies done by Davies[18] and Thompson[19] were masters' theses. The recent studies of Dugger,[20] Roger[21] and Hartzog[22] were doctor's dissertations. The purposes of the five studies varied slightly, although they were all related to training teachers.

Davies[23] used the teachers and farmers from his own and other states, while the other four studies limited their respondents to their own states. In four of the five studies young and adult farmers were selected by the teachers of agriculture as respondents. The present study is similar to four of the five studies mentioned above in that the farmer members of the advisory councils employed in the

---

[18]Llewellyn Rhys Davies, "Farm Shop Work in Vocational Education," (Master's thesis, Colorado Agricultural College, Fort Collins, 1923), p. 44.

[19]Clarence Tatman Thompson, "Farm Shop Jobs for Louisiana," (Master's thesis, Louisiana State University, Baton Rouge, 1938), p. 217.

[20]Roy Wesley Dugger, "Mechanical Competencies Needed by Vocational Agriculture Teachers in Oklahoma," (Doctor's thesis, Oklahoma Agricultural and Mechanical College, Stillwater, 1956), p. 118.

[21]Milford Shockley Rogers, "A Proposed Course of Study for Farm Mechanics in Vocational Agriculture in the Northeast Texas Area," (Doctor's thesis, Utah State University, Logan, 1957), p. 162.

[22]David H. Hartzog, "A Study of the Effect of a Survey of Farmer Opinion on Course of Study in Farm Mechanics," (Doctor's thesis, University of Minnesota, Minneapolis, 1959), n.p.

[23]Davies, op. cit., p. 44.

present study were selected by teachers and their local people.

There is similarity between Hartzog's and the present study in that "importance rating" and "taught or not" are checked for each ability. However, in this study, the teachers were asked to check "whether they taught the ability or not," while in Hartzog's study, farmers and teachers made the recommendations "whether each ability should be taught or not."

Abbott[24] developed a guide which teachers of vocational agriculture used in developing their summer program. The respondents were leaders in teacher education and selected graduate students in agricultural education.

Studies with three groups of respondents.--Cushman[25] secured data from all teachers of agriculture in Vermont, heads of agricultural engineering departments and state supervisors of agricultural education in the North Atlantic region. Rhoad[26] had three different groups of respondents.

---

[24]Charles F. Abbott, "What Are the Activities Which Should be Included in An Effective Summer Program of Work for a Teacher of Vocational Agriculture in New York?" (Master's thesis, Cornell University, Ithaca, 1957), p. 161.

[25]H. R. Cushman, "How Can the Agricultural Engineering Needs of Present and Prospective Teachers of Vocational Agriculture in Vermont Be Met?" (Non-thesis study, University of Vermont, Burlington, 1951), p. 85.

[26]Claude Elton Rhoad, "A Study of the Comprehensiveness of Abilities in Technical Agriculture Attained by Prospective Teachers of Vocational Agriculture in Ohio Previous to Their Entrance into Student Teaching," (Doctor's thesis, Ohio State University, Columbus, 1943), p. 342.

The subject-matter specialists suggested a list of "abilities teachers of vocational agriculture should possess." A jury of teacher trainers selected "essential" abilities from the above list. Tests and surveys were made to determine which abilities were possessed by the 26 seniors in the Department of Agricultural Education.

Studies with four groups of respondents.--Hamilton[27] and Matthew[28] both studied teacher training in the field of farm mechanics. They had four groups of respondents, and each study secured information from teachers of agriculture, specialists and selected farmers. Hamilton surveyed farmer members of advisory councils. Matthews interviewed young farmers. Hamilton sought opinions of leaders in teacher education, while Matthews obtained information from business people.

The present study is similar to that of Hamilton's in that, (a) all the respondents rate the importance of each ability, and (b) the teachers of agriculture check both the importance of each ability and the adequacy of training in

---

[27]James Roland Hamilton, "The Preparation of Michigan Teachers of Vocational Agriculture in Two Areas of Farm Mechanics," (Doctor's thesis, Michigan State University, East Lansing, 1955), p. 265.

[28]John Wilbur Matthews, "Basic Issues in Farm Mechancis Education with Implications for the Pre-Service Education of Teachers of Vocational Agriculture," (Doctor's thesis, University of Illinois, Urbana, 1957), p. 279.

each. The present study also asked teachers "whether or not they taught the ability," (in their high schools).

Studies on rural electrification relating to teacher preparation

Of the nine studies reviewed, seven studies employed one group of respondents, two studies used two groups of respondents.

Studies with one group of respondents.--In the 1950's three studies on the preparation of teachers of vocational agriculture in the field of rural electrification in Texas, Louisiana and South Dakota were conducted by Berry,[29] Curtis,[30] and Wells.[31] They all used teachers as respondents. The findings will be discussed later.

Birdwell,[32] McClay and others,[33] and Jackson[34]

---

[29]Berry, op. cit., p. 34.

[30]Charlie M. Curtis, "A Suggested Course of Study in Farm Electrification for Teachers of Vocational Agriculture in Louisiana," (Master's thesis, Louisiana State University, Baton Rouge, 1952), p. 34.

[31]George L. Wells, "A Survey of the Aspects of Teaching Rural Electrification in Vocational Agriculture in South Dakota," (Master's Problem South Dakota State College, Brookings, 1958), p. 72.

[32]Birdwell, op. cit., p. 18.

[33]David R. McClay, Frank Anthony, Richard N. Jones and Elwood R. Oliver, "Lessons on Wiring," (Non-thesis Study, Pennsylvania State University, State College, 1954), p. 40.

[34]Royce C. Jackson, "A Study of the Use of Electricity by 43 Farm Families in Rosebud, Texas," (Master's report Agricultural and Mechanical College of Texas, College Station, 1956), p. 18.

surveyed the opinions of farmers only. Birdwell and Jackson studied the use of electricity by farmers in two communities. McClay and others studied the most common problems confronting the farmers in the use of electricity so as to prepare a manual which could be used as a guide for teachers of agriculture and farmers.

Floyd Jones[35] collected data from 20 members in rural electrification co-operatives in Virginia. The respondents in his study were power suppliers. The present study also used power suppliers as one group of respondents.

Studies with two groups of respondents.--Horne[36] reported the participation of power suppliers in rural electrification education in land-grant colleges. The power companies and the leaders in teacher education in Virginia surveyed the needs and jointly prepared the course content to train the teachers of agriculture.

Sneep[37] used teachers of agriculture, farm-veteran teachers and power suppliers in Ohio to rate the electrical abilities for improving the teacher education.

---

[35]Floyd Jones, "What Are Your Members Thinking About?" Rural Electrification News, March, 1952, pp. 10-11.

[36]Horne, op. cit., pp. 1-3.

[37]Sneep, op. cit., p. 168.

Literature Related to Course Content of Rural Electrification

In order to find out the abilities that would be of importance in preparing Michigan teachers of agriculture in the field of rural electrification, the studies related to content were reviewed. Eight studies in other states and three in Michigan are reported.

The course content recommended by studies in states other than Michigan.--The studies in Louisiana, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas and Virginia reveal that the course content of each state is different.

Louisiana.--In 1949, the State Department of Education in Louisiana[38] suggested the following phases of rural electrification for the teachers of agriculture to teach:

Basic abilities--understanding sources of electricity, terms and materials.

Electrical equipment--selection, installation and maintenance

Wiring abilities--wiring the home and farmstead

Motors--selection, installation and maintenance

In 1952, Curtis[39] found the following phases important:

---

[38] Handbook for Effective Teaching of Farm Mechanics in the Vocational Agricultural Departments of Louisiana, Bulletin No. 671, Baton Rouge, Louisiana: State Department of Education, 1949, pp. 6-11.

[39] Curtis, op. cit., p. 45.

Basic abilities--principles of electricity, home appliances

Electrical equipment--selection and construction; water system

Wiring abilities--planning home and farmstead wiring system

Motors--electric motors

Lighting--home and farmstead lighting

Ohio--In 1957, Sneep[40] reported that the following abilities were agreed upon by the jury of specialists and the teachers to be important in instructing the teachers of agriculture:

Basic abilities--apply electricity to agriculture

Wiring--to extend wiring in presently wired building and new building; to maintain present wiring system; to determine when to replace or revise an inadequate wiring system.

Motors--to operate and to have adequate maintenance

Equipment--select electrical equipment economically

Oklahoma.--Dugger[41] ascertained that a majority of the interviewees agreed that farmers ought to have an extensive and personal understanding of the following "Electrical Competencies.":

---

[40] Sneep, op. cit., pp. 132-133.

[41] Dugger, op. cit., p. 63.

Basic abilities--estimating the cost of electrical wiring, power demand, power cost; selecting servicing and repairing electric appliances

Wiring--installing, repairing electric wiring

Motors--servicing motors and overload protectors

Lighting--selecting, servicing and repairing lighting equipment

Heating--servicing and repairing heating equipment

Pennsylvania--The eight lessons as a guide for teachers of agriculture in farm electrification were worked out by McClay[42] and others in their manual. These lessons are classified as:

Basic abilities--principles in construction of two or three-wire polarized circuits; how electricity is measured

Wiring--importance of adequate wire size; planning a wiring layout for a farm building a farmstead

Heating--heating with electricity

Lighting--using electric lighting on the farm

South Dakota.--In 1959, Larson[43] reported that the teachers of agriculture need to have the following abilities:

---

[42]McClay and others, op. cit., p. 40.

[43]Larson, op. cit., pp. 86-97.

Basic abilities--know electrical source, terms and symbols; identify sizes of wire and wiring; determine proper insulation

Wiring--wiring farmstead, select tools and supplies, splice wire, install hot and neutral wires, use of test lamps, use code book, construct brooders, repair light cords, replace fuses, repair broken wires, detect inadequate wiring

Motors--understand principles of motor, select and maintain motors, install motor, select proper size pulleys, reverse direction of rotation, properly wire motor for use; clean, install brushes; lubricate, clean and dress commutator of motors; figure running costs of electrical appliances and motors; determine the most economical way of doing a job; know advantages and disadvantages of electricity in the improvement of farm living conditions.

Texas.--In 1952, Berry[44] reported that a great majority of the teachers of agriculture indicated that the following jobs should be taught:

Basic abilities--to know electric terms, to read meters, to know cost of electricity, distribution of electricity, to check electrician's job, to know trouble shooting.

---

[44]Berry, op. cit., pp. 29-31.

Wiring--wiring small buildings, barns and houses; use wiring materials correctly

Equipment--to repair or build an electric brooder, simple repairs, electric welding

Safety--safety rules and precautions

Virginia.--Horne's report[45] in 1951 indicated that the following appeared to be the greatest needs of Virginia farmers and teachers of agriculture:

Basic abilities--to develop understanding of electricity and its use

Wiring--to secure assistance in planning a farmstead wiring system; to serve the present and foreseeable future needs of the farm and home

Equipment--to secure assistance in installation, operation, care and maintenance of electric installations and facilities; to secure assistance in making simple electric repairs and constructing electrical farm equipment.

Safety--to cultivate safety practices in electrical work.

Summary and comparisons of the eight studies.--The eight studies in the seven states other than Michigan indicate that:

---

[45]Horne, op. cit., p. 3.

(1) The course content in each of the eight studies varies, although they are similar in some aspects.

(2) "Basic abilities" and "wiring abilities" are recommended in all eight studies. It appears that these two sub-areas are fundamental and of vital importance to the teachers of agriculture.

(3) Abilities in the sub-areas "motors" and "equipment" are each reported in five of the eight studies. Abilities of each of the sub-areas "lighting","heating" and "safety" are mentioned in two of the eight studies.

(4) The number of abilities in each sub-area varies within the same study as well as among the different studies. Larson's study in South Dakota listed 26 very detailed abilities, while Louisiana's study very broadly mentioned four phases of abilities.

In the present study, six sub-areas with a total of 49 abilities are checked by respondents.

The reported needs of abilities from studies in Michigan

One community study.--Pfister[46] reported in 1953 that a majority of the farmers in the Imlay City community regarded the following abilities very important:

---

[46]Richard G. Pfister, "A Study to Determine How Important Various Farm Mechanics Skills Are to Successful Farmers in the Imlay Community," (Master's problem, Michigan State College, East Lansing, 1953), p. 33.

Wiring abilities--splicing electric wires, repair of light cord fixtures, replacement of worn outlets, plugs and switches, and building of an electric fence

A survey of 10 counties in Michigan.--Cook and Byram[47] reported in 1952 that a majority of the 673 farmers in 10 counties of Michigan had performed the following 12 activities in rural electrification. Table 4 shows the percentage of farmers who did each of the 12 abilities and the rank order of these abilities.

The activities which the majority of the farmers hired done and wished to make improvement in were:[48]

Wiring abilities--wiring building, splicing wire, repairing light cord fixture

Motor--making an electric motor portable

A majority of the farmers desired to improve the following eight activities they had performed:[49]

Basic abilities--make simple repairs of home appliances

Wiring--repair light cord fixture; build and install electric fence; splice wire

---

[47] Cook and Byram, op. cit., p. 63. (Data rearranged in Table 4).

[48] Ibid., p. 64.

[49] Ibid., p. 65.

TABLE 4.--Rank order of the frequencies of use of the 12 rural electrification activities performed by 643 farmers in Michigan, 1948.

Abilities (sub-area)	Per cent of farmers who did it	Rank
Lubricate motors (motor)	90.3	1
Adjust belt tension (motor)	89.6	2
Repair light cord fixture (wiring)	89.0	3
Make repairs for home appliances (basic abilities)	82.4	4
Splice wire (wiring)	81.0	5
Install electric fence (wiring)	75.4	6
Determine size of motor for given job (motor)	72.0	7
Build electric fence (wiring)	67.1	8
Install switches (basic abilities)	59.2	9
Install switch boxes (basic abilities)	54.8	10
Install convenience outlets (lighting)	53.7	11
Determine size of wire to use (wiring)	53.4	12

Basic abilities - 3; Wiring abilities - 5; Motors - 3; Lighting - 1; TOTAL abilities - 12.

From Cook and Byram, "Mechanical Activities of Selected Farmers in Michigan," p. 63. Based on data in TABLE XIX.

Motors--adjust belt tension, lubricate motors and determine size of motor for given job

A Study in seven midwestern states (including

Michigan).--Bollwahn[50] reported in 1961 that 406 short course students in seven midwestern states performed the following three abilities more than five times a year:

Basic abilities--read an electric meter

Motors--lubricate motors

Safety--know safety rules and precautions

The following abilities were suggested by Bollwahn[51] in teaching the short course students:

Basic abilities--know how electricity is made and distributed, read an electric meter, and understand electric terms

Safety--ground a machine, know safety rules and precautions

Motor--lubricate electric motors

Summary of the three studies and comparisons of them with the present study.--The three studies made in Michigan reveal the following:

(1) All the respondents were adult or young farmers. The farmers reported their own needs but not those of the teachers of agriculture. The present study asked the adult

---

[50] Lester Paul Bollwahn, "A Self Evaluation of Abilities in Farm Mechanics by Short Course Students in Agricultural Colleges with Implications for Instructional Program," (Doctor's thesis, Michigan State University, East Lansing, 1961), p. 64.

[51] Ibid., p. 123.

and young farmers to rate the relative importance of the 49 abilities for the preparation of their teachers.

(2) Each of the three studies had only one group of respondents, while the present study employed seven groups of respondents.

(3) The number and kinds of abilities needed by the farmers in each of the three studies varies. Pfister reported that five abilities were very important. Cook and Byram reported 15 abilities that the farmers would like to learn. Bollwahn suggested six abilities as essential in teaching short course students.

The present study has a check list of 49 abilities.

(4) Abilities on "wiring" were the most frequently mentioned in Pfister, Cook and Byram's studies, but Bollwahn did not suggest any one of them. The abilities found to be important in Pfister's non-thesis study in one community appear to be different from that of Bollwahn's. Pfister reported the importance of the sub-area "wiring" only, while Bollwahn suggested the needs of the other three sub-areas instead, namely: basic abilities, motor and safety.

Cook and Byram's study covered more sub-areas than the other two Michigan studies. It included "basic abilities," "wiring," "motors," and "lighting."

Implications of Literature Reviewed to the Present Study

Selection of respondents--The methods of selecting

different numbers and kinds of respondents from the studies in farm mechanics or rural electrification have led this writer to use seven groups of respondents for his investigation.

Compilation of Check-list.--The needed abilities as reported in the studies before 1958 have been evaluated, selected and compiled with other abilities recommended by the Subcommittee on Agricultural Teacher Training to make the first draft of the check-list.

Investigation of abilities.--Two techniques employed in some of the studies reviewed have been used in this investigation. That is to ask: (1) all the seven groups to rate the importance of the abilities, (2) all the teachers of agriculture to evaluate the adequacy of training of each of the 49 abilities. In addition to the above two investigations of all abilities, the present study also secured (3) the information from all teachers of agriculture regarding whether they "taught or not" each of the abilities in their high schools.

The literature reviewed as reported in this chapter is a good reference for (a) selection of respondents, (b) compilation of checklist and (c) investigation of abilities.

CHAPTER III

THE METHOD OF INVESTIGATION

The purpose of this chapter is to present the development of the method of investigation. The normative survey was used in the present study. The purposive sample was employed to obtain a composite opinion from seven groups who are associated to the rural electrification education for the Michigan teachers of agriculture. The geographic area included in the present study is the State of Michigan.

Three types of information were collected, as follows: (1) data pertaining to the relative importance of each ability, (2) data pertaining to the adequacy of training in each ability received by the teachers who responded, and (3) the frequency with which each ability was taught by those teachers.

The method of investigation is presented in the following sections: (1) the development of the survey forms, (2) the selection of respondents, (3) the collection of data and (4) the method of organizing and analyzing the data.

Development of the Survey Forms

The development of the first draft check-list.--The

abilities in rural electrification compiled in the first draft check-list were mainly from: (1) the abilities suggested by the agricultural engineers who have taught rural electrification courses to the teachers and the farmers in Michigan in recent years, (2) the abilities based on the recommendations of the Sub-Committee on Agricultural Teacher Training, (3) the studies reviewed in the previous chapter, and (4) books[1] and manual[2] on electricity.

The original check-list contained seven sub-areas, with a total of 75 abilities. It was an open end check-list for the respondents to suggest additional abilities. They were asked to add, delete and revise it.

The respondents who revised the trial check-list were agricultural engineers, state leaders in teacher education, prospective teachers of agriculture and the young farmers who enrolled in the rural electrification courses.

As a result of the suggested abilities made by the people mentioned above, an "enlarged check-list" was developed.

---

[1]Many books and literature were used as reference but the main sources were from: Brown, op. cit.; Van Valkenburgh, Nooger and Nevill, Inc., Basic Electricity, Vol. 1 and 2, John F. Rider Publisher, Inc., New York 11, N.Y., 1954; and Wright, op. cit.

[2]State Department of Agricultural Education, Farm Electric Demonstration Manual for Vocational Agriculture Instructors (St. Paul, Minn., State Department of Agricultural Education, 1958).

It was revised, through the suggestion of the agricultural engineers who have taught rural electrification courses recently. It then became a semi-final check-list of abilities.

Trial of the semi-final check-list.--This check-list was submitted to a few students who enrolled in the rural electrification courses at Michigan State University. This was done in order to find out whether or not the abilities in it were understandable. It was found that most of the abilities were sufficiently specific and clear for them to understand, although some minor changes were recommended and the revision was made accordingly.

The final check-list of two forms.--The final check-list includes six sub-areas and a total of 49 abilities. Two forms of the instrument were prepared: (1) Form A,[3] which was sent to the teachers of agriculture to check the importance, the adequacy of training and the frequency with which they have taught each of the 49 abilities. (2) Form B,[4] which was sent to the other six groups of respondents to evaluate the importance of each of the 49 abilities. (It is only one of the three parts of Form A.)

Both Form A and Form B were submitted to the members of the writer's graduate study committee and the members of the seminar of agricultural education, drawing upon their advice and counsel. Finally these two forms of the instruments were developed. The next problem was to select the

---

[3]Appendix A.

[4]Appendix B.

respondents to secure the needed information.

The Selection of Respondents

On the subject of course content, Byram and Wenrich[5] suggest student-teacher cooperative planning. It implies that the students have a part in deciding what is to be learned. The present study is an attempt to have student-teacher cooperative planning in determining the course content, therefore, the following groups are included as respondents:

(1) Those students who had the course A.E. 412 and who are now serving as the teachers of agriculture in Michigan.

(2) Those students who are enrolled in A.E. 412 and now planning to be the teachers of agriculture.

(3) The leaders in teacher education and the agricultural engineers who have been the instructors in rural electrification.

Byram and Wenrich[6] also mention the importance of making contacts with organizations in trade, farm and business associations in planning course content. Since power suppliers in Michigan are important industrial organizations in rural electrification and many of the farm service advisors

---

[5]Byram and Wenrich, op. cit., p. 337.

[6]Ibid.

have participated in rural electrification education in Michigan, these rural servicemen were asked to be respondents in the present study.

Cook and others,[7] and Byram and Wenrich[8] suggest that farmer members of advisory councils and/or successful farmers be used as a source of information for teaching content in agriculture, therefore farmer members of advisory councils were used as respondents.

As mentioned in Chapter II, more than one third of the 35 studies reviewed asked the opinions of young or adult farmers. The present study used the farmer members of advisory councils to represent successful adult farmers and the Short Course students enrolled in rural electrification class A.E. 7 as young farmers. These young farmers were the students of the teachers of agriculture and they were interested in learning more abilities in rural electrification. Therefore, seven groups of respondents were secured in the present study.

The number of persons in each of the seven groups is shown in Table 5. The variation of the number of persons in each of the seven groups is due to the differences in: (a) the total number of persons eligible to participate, (b) the number of eligible persons solicited, and (c) the

---

[7]Cook, Walker, and Snowden, op. cit., pp. 206-207.

[8]Byram and Wenrich, op. cit., pp. 206-207.

TABLE 5.--Groups, numbers and percentages of respondents in Michigan reporting rural electrification abilities.

Respondents by group	Number solicited	Number reporting	Per cent reporting
State leaders in teacher education	20	19	95.0
Teachers of vocational agriculture	56	47	83.9
Prospective teachers of agriculture	27	25	92.6
Agricultural engineers	15	15	100.0
Rural servicemen	34	28	82.3
Farmer members of advisory councils	55	32	58.0
Young farmers	50	50	100.0
Total	257	216	84.0

number of persons whose reports were valid. For instance, the total number of persons eligible to participate in the young farmer groups was much greater than the number of agricultural engineers, therefore, more young farmers than agricultural engineers were included in the present study.

Selection of leaders in teacher education.--There are 19 leaders in teacher education reporting in the present study as revealed in Table 5. They were selected on the criteria listed below:

(1) The respondent is a member of the staff in agricultural education of the department of teacher education at Michigan State University including the supervising teachers; or (2) the respondent is qualified by having had experience in teacher education; or (3) the respondent has taken a college course in rural electrification and/or has had practical experience of a nature deemed adequate to qualify him as a specialist in vocational education in agriculture; or (4) the respondent is a state consultant in agricultural education of the Michigan State Department of Public Instruction; or (5) the respondent is qualified by having had experience as a consultant in vocational education in agriculture at the state level.

The close relationship existing between the state leaders in teacher education, and the teachers of agriculture, make the former aware of the needs of teachers for various abilities connected with rural electrification.

Selection of the teachers of agriculture.--The 47 teachers of agriculture[9] reporting in Table 5 were selected on the following criteria: (1) The respondent is a certified and regular teacher of vocational agriculture, (2) He is certified to teach farm mechanics, (3) He is now teaching farm mechanics, or has taught this subject recently, (4)

---

[9]A list of the names and their locations is in Appendix C.

He has taken the rural electrification course in Michigan State University between 1950 and 1957, or (5) He has had a very good farm mechanics program and/or a very active advisory council to give sound judgment in suggesting rural electrification needs of teachers even though he did not study the prescribed course at the designated period. (6) He has a "better than average" program.

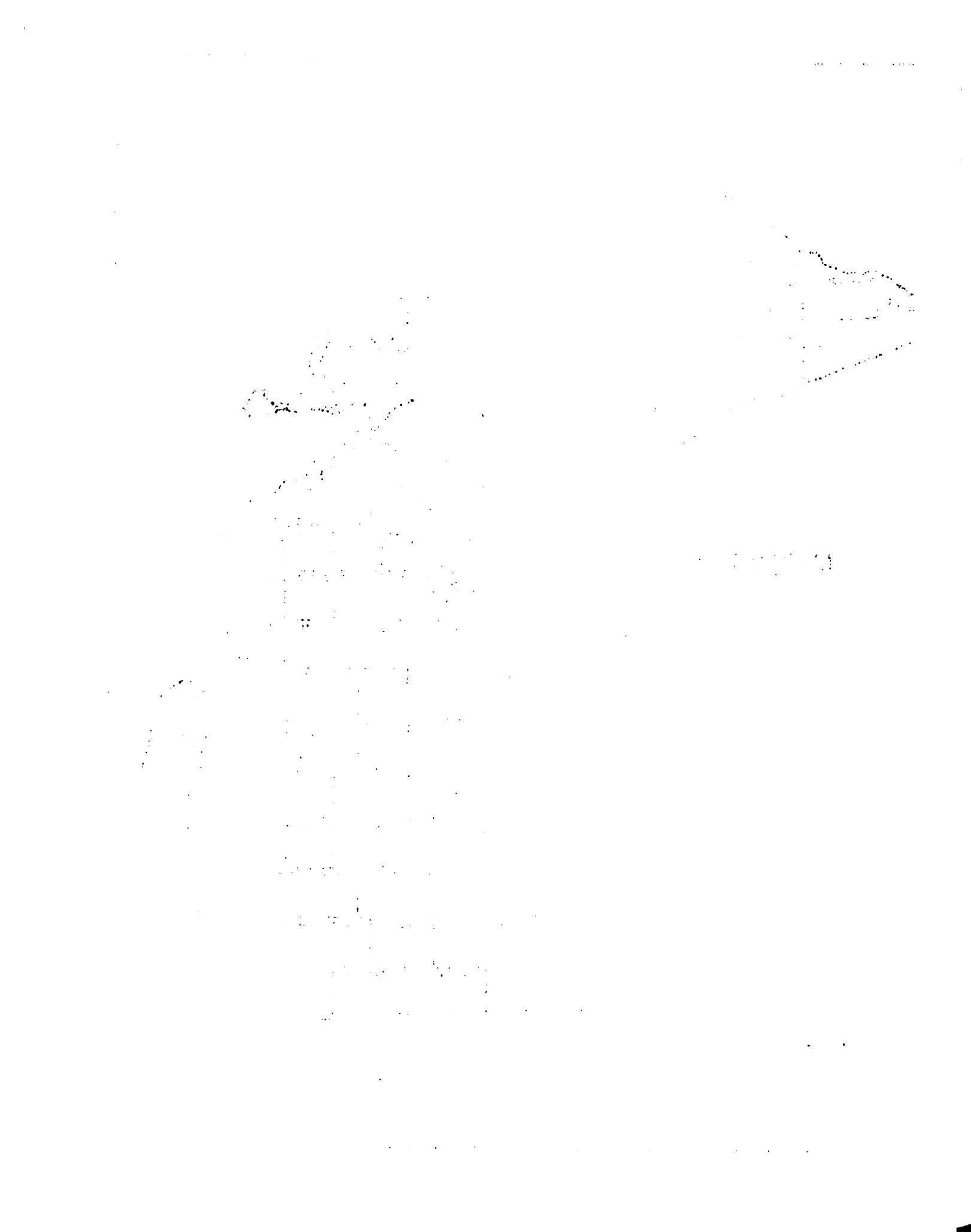
Based on the above criteria, the writer secured the help of a few leaders in teacher education in selecting the eligible teachers as respondents.

A study of the data on which Table 5 is based shows that 56 teachers are included in the present study, while the total number in Michigan in the year 1959 was 265. Only about 21 per cent of the teachers were eligible to participate. Due to the strict criteria and low eligibility, all those teachers who were eligible were solicited. Forty-seven of 56 teachers, or about 84 per cent of them responded.

Figure 1 shows the geographic distribution of the 47 teachers representing 45 schools which are located in 27 counties in Michigan. Only one respondent is located in the Upper Peninsula. The distribution is concentrated on the southern part of the Lower Peninsula.

Selection of prospective teachers.--The term "prospective teachers" used in the present study denotes those students who were enrolled in college rural electrification course A.E. 412, which was designated for agricultural

Fig. 1.--Geographic distribution of 47 teachers in 45 schools located in 27 counties in Michigan.



education majors. It was found that 27 of the 36 students in the class A.E. 412 were planning to be teachers of agriculture. All of them were solicited to rate Form B, and 25 persons reported. The percentage of reports returned is 92.6.

Selection of agricultural engineers.--The term "agricultural engineers" denotes the staff members in the Agricultural Engineering Department at Michigan State University. The 15 respondents from this department were selected on the following criteria: (1) He is a member of the staff of the Department of Agricultural Engineering at Michigan State University. (2) He has taken adequate course work in rural electrification. (3) he has taught a rural electrification course for the preparation of teachers of agriculture or young farmers in the Short Course; or (4) He has had research or extension experience related to rural electrification in Michigan.

Table 5 reveals that 15 members are eligible. All of them were solicited and the reporting is 100 per cent.

Selection of rural servicemen.--Rural servicemen are the group of respondents from the power suppliers in Michigan. The criteria used to select them were: (1) The respondent is a full-time employee of a power supplier organization in Michigan. (2) He has experience in rural electrification education in Michigan. (3) he has contacts with the teachers of agriculture and the farmers in the

district where he is serving and is aware of their problems in rural electrification.

Table 5 reveals that a total of 34 persons were eligible to be respondents and all of them were solicited. Since six of the forms were incomplete only the reported forms of 28 respondents in this group are used in the present study.

A great majority of the 10 respondents of the 10 rural electrification cooperatives were managers. All of the 18 persons from the 14 district offices were farm service advisors. The geographic distribution of the respondents representing power suppliers in Michigan is shown in Fig. 2.

Selection of farmer members of advisory councils.--With the advice and counsel of a few state leaders in teacher education, the writer selected 11 schools which were considered to have: (1) active advisory councils, (2) very good farm mechanics program in their vocational agricultural departments, and (3) excellent relations between the teachers of agriculture and their farmer members of advisory councils.

The criteria used to select the farmer members of advisory councils were: (1) The respondent is a farmer and regular member of the advisory council and has had one year's active participation in the council, and (2) His opinion is valuable in the area of rural electrification.

Fig. 2--Geographic distribution of the 28 rural servicemen from 24 offices of power suppliers located in 23 counties in Michigan.

Since farmer members of advisory councils are elected by local people and are regarded as successful farmers in that region, they are selected local leaders. They are generally the parents of students in the school and they know the demands and interests of the farmers in the community as well as the needs of the students in the school. Therefore, the two criteria mentioned above were selective enough to secure valid information required in the present study.

Since the teachers of agriculture in local schools knew the farmer members of their advisory councils, they were asked to select five farmer members as respondents. Only 58 per cent of the total number of those solicited reported. This is the lowest percentage of reporting among the seven groups of respondents.

The reasons for this low percentage of response may be due to: (1) A majority of the advisory councils may not have had five farmer members eligible to be the respondents, and (2) the check-list sent to each of the farmer members was through the teacher in each school. This indirect relationship (selection and mailing) and process may have been the cause of fewer returns.

The geographic distribution of the 32 farmer members of the 11 advisory councils from the 11 schools located in nine counties in Michigan is shown in Fig. 3.

Selection of young farmers.--There were 81 Short

Fig. 3.--Geographic distribution of 32 farmer members of 11 advisory councils from the 11 schools in nine counties in Michigan.

Course students in rural electrification A.E. 7. The criteria used to select the respondents were: (1) The respondent is a regular student enrolled in A.E. 7, (2) He studied the farm mechanics course or courses in high school and (3) He has some farming experience. The fact that these students enrolled in A.E. 7 indicates their interest in rural electrification. To avoid the misunderstanding of the relation between this survey and their grades in A.E. 7, it was decided to let them check the survey Form B voluntarily. It was hoped that those who responded in this way really showed their interest and their ratings would be reliable and valid.

Table 5 shows that 50 copies of survey Form B were returned by the young farmers. About 62 per cent of the 81 students reported.

Method of Procuring Data

After the survey forms were printed and the seven groups of respondents were selected, the Form A was sent to the teachers of agriculture and Form B was sent to the other six groups. The methods of procuring data were as follows.

Coding the forms and envelops.--Because it was planned for each of the seven groups of respondents to be analyzed separately as well as collectively, each of them was coded with numbers. The envelops mailed to the teachers,

farmer members of advisory councils, rural servicemen and others were marked with the coded numbers. This facilitated the process of filing and analyzing the data.

Collecting survey forms in classes.--The group of young farmers enrolled in Short Course A.E. 7 and the group of prospective teachers enrolled in A.E. 412 had participated in the compilation of the list of abilities and they knew the purpose of the present study. The instructors followed the criteria mentioned and explained the directions for checking the survey forms.

Procuring survey forms from leaders in teacher education and agricultural engineers.--A great majority of the state leaders in teacher education and all agricultural engineers were contacted in person. Most of the respondents from these two groups had helped the writer to design the present study; the percentages of returns were very high. A few leaders in teacher education were not in Lansing or East Lansing and the data were collected by mail.

Collecting information by mail.--The information was secured from (1) the teachers of agriculture, (2) the farmer members of advisory councils and (3) the rural servicemen by mail.

Letters[10] covering the nature, purpose and the

---

[10]Appendices D, E, F, G, and H.

directions for checking the survey forms were prepared for the various groups of respondents. A follow-up letter was sent to those respondents who failed to return the form about three weeks after the mailing date. More than 99 per cent of the survey forms used in the present study were returned before May 10, 1959.

Method of Organizing and Analyzing the Data

The data was first tabulated and then some statistical analyses were employed. The tabulation of importance scores of 49 abilities by the seven groups is shown in Table 6.

Tabulation of the data

There are several kinds of scores and rank order. The tabulation of each is as follows:

Importance scores.--Importance scores were rated by the 216 respondents. For each ability two points are given to the rating of "very important," one point to "fairly important" and zero point to "relatively unimportant."

Training scores.--Training scores were rated by the 47 teachers in the high schools. If the training was rated "adequate," it is weighted two points, "fairly adequate" is weighted one point and no point is given for "inadequate" training.

Application scores.--Application scores were rated

TABLE 6.--Tabulation of importance scores of 49 abilities on rural electrification by seven groups in Michigan, 1959.

Sub-area and ability number	19 Leaders in teacher education						47 Teachers of agriculture					
	No. very important	No. fairly important	No. relatively unimportant	Total score of each ability	Mean score of each ability	Rank within each sub-area	No. very important	No. fairly important	No. relatively unimportant	Total score of each ability	Mean score of each ability	Rank within each sub-area
I. Basic abilities												
1.	8	10	1	26	1.37	8	11	25	11	47	1.00	10
2.	12	5	2	29	1.53	7	20	20	7	60	1.28	7
3.												
...												
11.	3	11	5	17	0.89	11	4	19	24	27	0.57	12
12.	4	5	10	13	0.68	12	10	27	10	47	1.00	10
Total score				332						760		
Mean score					1.46						1.35	
Rank among 6 sub-areas						5						5

by the 47 teachers in high schools. If a teacher taught an ability, the application score is two points. If he did not teach it, the application score is zero.

Mean scores.--Mean scores are the total scores divided by the number of respondents. For instance, in Table 6, the total score of importance of sub-area I, ability 1 (or ability I-1) is 26. It was rated by 19 leaders in teacher education, so the mean score is 26 divided by 19, or 1.37.

Mean score of sub-area.--The mean score of the sub-area is shown in Table 6. The total score of the 12 abilities in the sub-area I as rated by the 19 leaders in teacher education is 332. The mean score is $332 \div (12 \times 19) = 1.46$. The total score is 332. It is divided by the product of 12, the number of abilities in the sub-area, and 19, the number of respondents.

Similarly, the mean score of the sub-area I as rated by the 47 teachers is $760 \div (12 \times 47) = 1.35$.

Rank order.--Rank order is arranged according to the size of the mean scores. For instance, in Table 6, the ability I-1 is ranked the eighth of the 12 abilities, since its mean score is the eighth highest. Similarly, the ability I-1 was ranked the 10th by the 47 teachers.

Table 6 is an illustration of the method of tabulation of all the mean scores and ranks as recorded.[11]

---

[11] Appendix I.

Statistical Analysis

The following statistical tests were applied in the analysis of the data and testing hypotheses.

t-test.--In determining the significance of difference between mean scores of importance of various abilities reported by the 216 respondents, the following t-test was used:[12]

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_p\sqrt{1/N_1 - 1/N_2}}$$

where

$\bar{X}_1$ = mean score of importance of the first ability

$\bar{X}_2$ = mean score of importance of the second ability

s_p = $\sqrt{\text{the pooled mean-square estimate of } \sigma^2}$

N_1 = the number of respondents who rated the first ability

N_2 = the number of respondents who rated the second ability

$N_1 = N_2 = 216$, because the number of respondents in rating both abilities were the same. (for hypothesis one)

---

[12]Wilfrid J. Dixon and Frank J. Massey, Introduction to Statistical Analysis (New York: McGraw-Hill Book Co., 1957), pp. 109-121.

t-test was used in hypotheses one[13] and five.[14]

Spearman Rank Correlation.-- The Spearman rank correlation coefficient was used to determine the degree of independence (or relationship) between two variables which have been ranked on a comparative basis. The rank correlation coefficients are developed according to the following formula:[15]

$$r_s = 1 - \frac{6\Sigma d^2}{N(N^2 - 1)}$$

where

d = difference in rank

N = number of paired items or ranks

This test was applied to determine (a) whether there is significant relationship between the rankings of the six sub-areas as rated by the seven groups, and (b) whether there is significant relationship in the rank order of the 49 abilities as rated by the composite and the three ratings by the teachers.

The above test was used in hypotheses two[16] and six.[17]

---

[13] Infra, p. 79 (Chap. IV, Table 8)

[14] Infra, p. 145 (Chap. IV, Table 22)

[15] George W. Snedecor, Statistical Methods (The Iowa State College Press, Ames, Iowa, fifth edition, 1956), pp. 190-191.

[16] Infra, p. 91 (Chap. IV, Table 12)

[17] Infra, p. 151 (Chap. IV, Table 25)

Analysis of variance.--To test the hypothesis that the disagreement among the seven groups in their ratings of the importance of all abilities is not significant, analysis of variance was used. Analysis of variance is an appropriate method to use when seeking statistical evidence for accepting or rejecting a hypothesis in which several groups are compared simultaneously.[18]

The table of analysis of variance is presented in Table 15 in the following chapter.

In order to test the significance, an F ratio test was calculated:

$$\text{F ratio} = \frac{\text{Mean square among the seven groups}}{\text{Mean square within each group}}$$

The calucation of the mean square was by Snedecor's method.[19] As will be seen in Table 15 of Chapter IV,[20] the F ratio is 2.44. This indicates that the variation of the means among the seven groups is significant at the five per cent level.

To determine whether or not the mean score of each group is significantly different from the other, Duncan's

---

[18] Snedecor, op. cit., Chapter 10.

[19] Ibid., pp. 240 and 269.

[20] Infra, p. 105 of Chapter IV, Table 15.

"Multiple Range and Multiple F Test"[21] was used.

The above method was used to test hypothesis three.

Coefficient correlation.--Linear coefficient correlation was used to test the independence between any two of the three variables: (a) the mean score of importance, (b) training, and (c) application as rated by 47 teachers.

The formula to find the correlation coefficient, r is,[22]

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}}$$

where

X = the observed value of score on the x-axis.

Y = the observed value of score on the y-axis.

N = the number of respondents, which is 47.

---

[21]David B. Duncans, "Multiple Ranges and Multiple F Test," Biometric, (March, 1955), 11:1, pp. 1-41.

[22]Fredrick E. Croxton and Dudley J. Cowden, Applied General Statistics (Englewood Cliffs, New Jersey: Prentice Hall, Inc., second edition, 1960), pp. 454-469.

CHAPTER IV

PRESENTATION OF FINDINGS

To find a basis for course content, two subsidiary purposes of the present study are: (1) to determine what abilities, in order of importance, are needed by Michigan teachers of agriculture in pre-service training and (2) to determine what abilities are needed for in-service training of the Michigan teachers of agriculture.

Seven groups, with a total of 216 respondents were asked to evaluate the importance of the 49 abilities so as to determine the relative importance of each of the 49 in the preparation of teachers. This is a basis for the course content in the training of prospective teachers.

To determine what abilities are needed for in-service training of the teachers, 47 teachers were asked to evaluate the 49 abilities with respect to (a) importance, (b) training and (c) application. Based on the composite rating, the abilities that the teachers need more training in will make up the content for in-service training.

There are three parts in this chapter: (1) the evaluation of importance by the seven groups, (2) the evaluation by 47 teachers and (3) comparison of the evaluation of the two.

The Evaluation of Importance by Seven Groups

To differentiate the degree of importance of the 49 abilities, the following methods were used: (1) to find the rank order of importance of the 49 abilities rated by the 216 respondents of the seven groups so as to determine the preference on each ability. (2) To determine whether the degree of importance of some of the abilities rated by 216 respondents varies significantly. This is the basis for discriminating or differentiating between abilities. (3) To find the rank order of importance of the six sub-areas. (4) To find the rank order of the abilities within each sub-area. (5) To determine the degree of agreement among the seven groups on the importance of all 49 abilities. This is a reference for planning the course content. Each of the above points is to be discussed in the following:

Rank order of 49 abilities by 216 respondents.

The rank order of importance of the 49 abilities is arranged in Table 7. The ability ranking the highest has a mean score of 1.88. The ability ranking the lowest has a mean score of 0.78.

The grand mean score,[1] which is the mean score of the 49 abilities rated by the 216 respondents, is 1.43.

---

[1] See Appendix I,

Since the grand mean score is between 1.00 and 2.00, it is between "fairly important" and "very important."

Twenty-five of the 49 abilities, or 51 per cent, have mean scores greater than 1.50. Eighteen of the 49, or 36.8 per cent of abilities have mean scores between 1.00 and 1.50. Only six abilities, or 12.2 per cent, have mean scores below 1.00, or the "fairly important" level. This indicates that a great majority of the abilities as rated by the 216 respondents are above the "fairly important" level.

Abilities with very high ranks.--In Table 7, of the first nine highest ranks, six of them belong to sub-area VI, safety, as indicated by the parentheses after the abilities which rank second, third, fifth, seventh, eighth and ninth. Abilities of the first and the sixth ranks deal with "fuses for protection" and "locate hazards." They are also related to safety. This reveals that abilities related to safety were ranked very high by the 216 respondents.

Abilities with very low ranks.--In Table 7, the six abilities, ranked from 44th to 49th, have mean scores less than 1.00. These six abilities are rated "relatively unimportant," according to the rating system used in the present study. Three of these abilities belong to the sub-area basic abilities. They are: "Install remote control," "Install time clock switch, thermostatic switch," and "Charge storage battery." The other three abilities with very low ranks are in the heating and cooling sub-area. They are:

TABLE 7.--Rank order of mean scores of importance of 49 abilities in rural electrification as rated by 216 respondents in Michigan

Ability	Mean score of importance	Rank
I. First Degree of Importance (mean score above $\bar{X}$ + s)		
Determine types and sizes of fuses for protection (I-7)*	1.880	1
Ground equipment and wiring system safely (VI-1)	1.866	2
Recognize hazards of sub-standard wiring (VI-6)	1.830	3
Select proper types and sizes of motors (III-1)	1.824	4
Prevent electric shock (VI-4)	1.778	5
Locate hazards such as short or open circuits . . . (I-8)	1.764	6
II. Second Degree of Importance (mean score from $\bar{X}$ to $\bar{X}$ + s)		
Install fire-proof lighting fixture in hayloft properly (VI-3)	1.759	7
Use fire fighting equipment for electric fires (VI-5)	1.730	8
Make electric fence controller safe (VI-2)	1.722	9
Plan wiring system for present and future loads (II-1)	1.694	10
Select proper overload protection (III-2)	1.690	11
Select wiring materials (types, sizes . . .) (II-3)	1.681	12
Interpret motor nameplate information (III-7)	1.667	13

*(I-7) . . . See Appendix A check-list, sub-area I, ability number 7.

TABLE 7 - Continued

Ability	Mean score of importance	Rank
Repair damaged cords and make proper splices (I-9)	1.657	14.5
Select pulleys and belts for machine of desired speed (III-8)	1.657	14.5
Comply with electrical code and select Underwriters' Laboratory approved materials (I-6)	1.653	16.5
Recognize effects of poor lighting in quality and quantity (IV-1)	1.653	16.5
Protect buildings from hazards of lighting (VI-7)	1.597	18
Install heat lamps for pig or chicken brooding (V-1)	1.583	19
Use judgment to revise present wiring system (II-10)	1.565	20
Wire a circuit for general purpose lights and outlets (II-8)	1.542	21
Clean and lubricate motors (III-3)	1.537	22
Locate outlets and switches (II-6)	1.528	23
Select electrical appliances for convenience, economy and safety (I-2)	1.519	24
Determine number of branch circuits in new buildings (II-5)	1.500	25
Mount motor and adjust belt tension (III-9)	1.486	26
Recognize sources of reliable information on rural electrification (I-5)	1.458	27
Select lighting equipment for home and yards (IV-4)	1.454	28

TABLE 7 - Continued

Ability	Mean score of importance	Rank
Determine light requirements for various areas and jobs (IV-2)	1.444	29
Compare cost of electricity with other sources of power (I-3)	1.444-	30
III. Third Degree of Importance (mean score from $\bar{X}$-s to $\bar{X}$)		
Locate load center and distribution center (II-2)	1.421	31
Select service-entrance switches (II-4)	1.417	32
Install 3-way and 4-way switches (II-7)	1.407	33
Install light fixtures (IV-5)	1.589	34
Use ultraviolet lamp and other special lamps safely (VI-8)	1.324	35
Wire a circuit for special outlets (as: range, welder . . .)(II-9)	1.306	36.5
Determine voltage drop and its effect on lighting (IV-3)	1.306	36.5
Change direction of rotation of motor (III-4)	1.209	38
Compute energy consumption of various appliances (as: range, welder . . .) (I-4)	1.208	39
Replace brushes in motors (III-6)	1.162	40
Change voltage of dual voltage motor (III-5)	1.120	41
IV. Fourth Degree of Importance (mean score from $\bar{X}$-2s to $\bar{X}$-s)		
Determine water requirements in gallons per hour for home and farmstead (V-4)	1.097	42

TABLE 7 - Continued

Ability	Mean score of importance	Rank
Compute monthly bills from meter and rate schedule (I-1)	1.056	43
Determine cost of heating home with electricity (V-2)	0.903	44
Charge storage battery (I-12)	0.866	45
Install time clock switch, thermostatic switch (I-10)	0.856	46
V. Least Degree of Importance (mean score below $\bar{X}$-2s)		
Calculate heat in BTU which must be removed to cool farm products (V-3)	0.755	47
Install remote controls (I-11)	0.634	48
Install air conditioner (V-5)	0.477	49

"Install air conditioner," "Calculate heat in BTU which must be removed to cool farm products," and "Determine cost of heating home with electricity."

Degree of importance of 49 abilities.--To differentiate the degree of importance of the 49 abilities, they were divided into five intervals or levels. The division is based on the grand mean (1.43) and the standard deviation s, (0.33).

In Table 7, the abilities with ranks from the first to the sixth have mean scores above the value of $\bar{X}$+s. They are in the first degrees of importance.

The division of the 49 abilities into the first, second, third, fourth and fifth degrees of importance is shown in Table 8. Twenty-four of the 49 abilities, or 48.99 per cent are rated in the second degree of importance. That is, about half of all abilities have mean scores between 1.43 and 1.76.

TABLE 8.--Distribution of mean score of importance of 49 abilities in rural electrification reported by 216 respondents in Michigan, 1959.

Interval	Deviation from grand mean, $\bar{X}$	Frequency	Per cent	Degree of importance	Rank order
1.76-2.09	$\bar{X}$+s to $\bar{X}$+2s	6	12.24	first	1-6
1.43-1.76	$\bar{X}$ to $\bar{X}$+s	24	48.99	second	7-30
1.10-1.43	$\bar{X}$-s to $\bar{X}$	11	22.45	third	31-41
0.77-1.10	$\bar{X}$-2s to $\bar{X}$-s	5	10.20	fourth	42-46
0.44-0.77	$\bar{X}$-3s to $\bar{X}$-2s	3	6.12	least	47-49
Total		49	100.00		1-49

Similarly, 11 abilities have mean scores between 1.10 and 1.43. They are in the third degree of importance. There are five and three abilities in the fourth and the least degrees of importance respectively.

The significance level of the difference of some abilities

To test the null hypothesis that the variability of importance of any of the 49 abilities as rated by the

216 respondents is insignificant, five abilities were selected. Each of the five selected abilities is the first ability of each of the five intervals mentioned in Table 8. That is, the abilities with the ranks of first, seventh, 31st, 42nd and 47th are the first abilities in the first, second, third, fourth and fifth degrees of importance respectively as indicated in Table 7.

The t-test of the means--To find the difference of the two mean scores between abilities of the first and the seventh rank, the t-test was applied as shown in Table 9. Similarly, the differences between the means of the abilities with ranks of seventh and 31st, 31st and 42nd, and 42nd and 47th are all statistically significant at the one per cent level.

Since the differences of the means of the abilities in Table 9 are all significant at the one per cent level, the null hypothesis, that the variability of importance scores of any of the 49 abilities as rated by the 216 respondents is not significant, is rejected. That is, the differences between the means of the abilities can be used to select the abilities with the higher ranks for the preparation of teachers. Greater emphasis should be given to those abilities with the higher ranks.

Rank order of importance of six sub-areas rated by seven groups

To determine the rank order of importance of the

TABLE 9.--Significance of difference between mean scores of importance of various abilities reported by 216 respondents in Michigan.

Mean score difference between two abilities						
Rank	Degree of importance	Mean score	Rank	Degree of importance	Mean score	Level of significance
1	first	1.880	7	second	1.759	$p<0.01$
7	second	1.759	31	third	1.421	$p<0.01$
31	third	1.421	42	fourth	1.097	$p<0.01$
42	fourth	1.097	47	fifth	0.477	$p<0.01$

Data from Table 7.

sub-areas, the mean scores of each of the seven groups was calculated first. The tabulation of the mean scores of sub-area I, (basic abilities) for leaders in teacher education group was shown in Table 6.[2] The total scores of these 12 abilties as rated by 19 leaders in teacher education and by 47 teachers of agriculture are 332 and 760 respectively, and the mean scores of sub-area I rated by the two groups are 1.46 and 1.35.

All the mean scores of each sub-area rated by each of the seven groups are recorded in Appendix I, and presented

[2] Supra, p. 66.

in Table 10. The highest mean score rated by the composite (or seven groups) in Table 10 is 1.70. It is in the sub-area safety. The lowest mean score rated by the composite is 0.96, which is in the sub-area heating and cooling.

Based on the mean scores of the six sub-areas by the composite and the seven groups in Table 10, the profiles of Figs. 4, 5 and 6, and the ranks of the six sub-areas rated by each group is presented in Table 11. Before comparing the ranks, it is intended to show the actual differences between the sub-area means as rated by each group and by the composite of the groups.

Comparison of the profiles.--Figure 4 compares the profiles of the ratings by leaders in teacher education, teachers of agriculture and the prospective teachers and the composite on each of the six sub-areas. Heating and cooling is the lowest of the six sub-areas. Safety is the highest. The degree of agreement between the composite and each of the three groups is indicated by the distances or gaps between the composite and the respective profiles. For instance, in sub-area I, basic abilities, the upper point of the profile of the leaders in teacher education is far away from the upper point of the composite, while the other two profiles in the sub-area basic abilities are near the composite. This shows more agreement between the two groups and the composite than between leaders in teacher education and the composite,

TABLE 10.--Mean score of importance of rural electrification abilities in six sub-areas reported by seven groups of respondents in Michigan

Groups	Mean score of six sub-areas						
	Basic abilities	Wiring	Motors	Lighting	Heating and cooling	Safety	Total
Composite	1.33	1.51-	1.49	1.45	0.96	1.70	1.43
Leaders in teacher education	1.46	1.47	1.67	1.59	1.02	1.783	1.52
Teachers of agriculture	1.35	1.61	1.60	1.53-	0.96	1.779	1.50
Prospective teachers	1.32	1.54	1.57	1.50	1.06	1.775	1.48
Agricultural engineers	1.43	1.49	1.66	1.53+	0.88	1.59	1.46
Rural servicemen	1.27	1.46	1.44	1.41	1.04	1.73	1.41
Farmer members of advisory councils	1.31	1.37	1.43	1.32	0.98	1.68	1.37
Young farmers	1.30	1.52	1.29	1.38	0.86	1.59	1.35

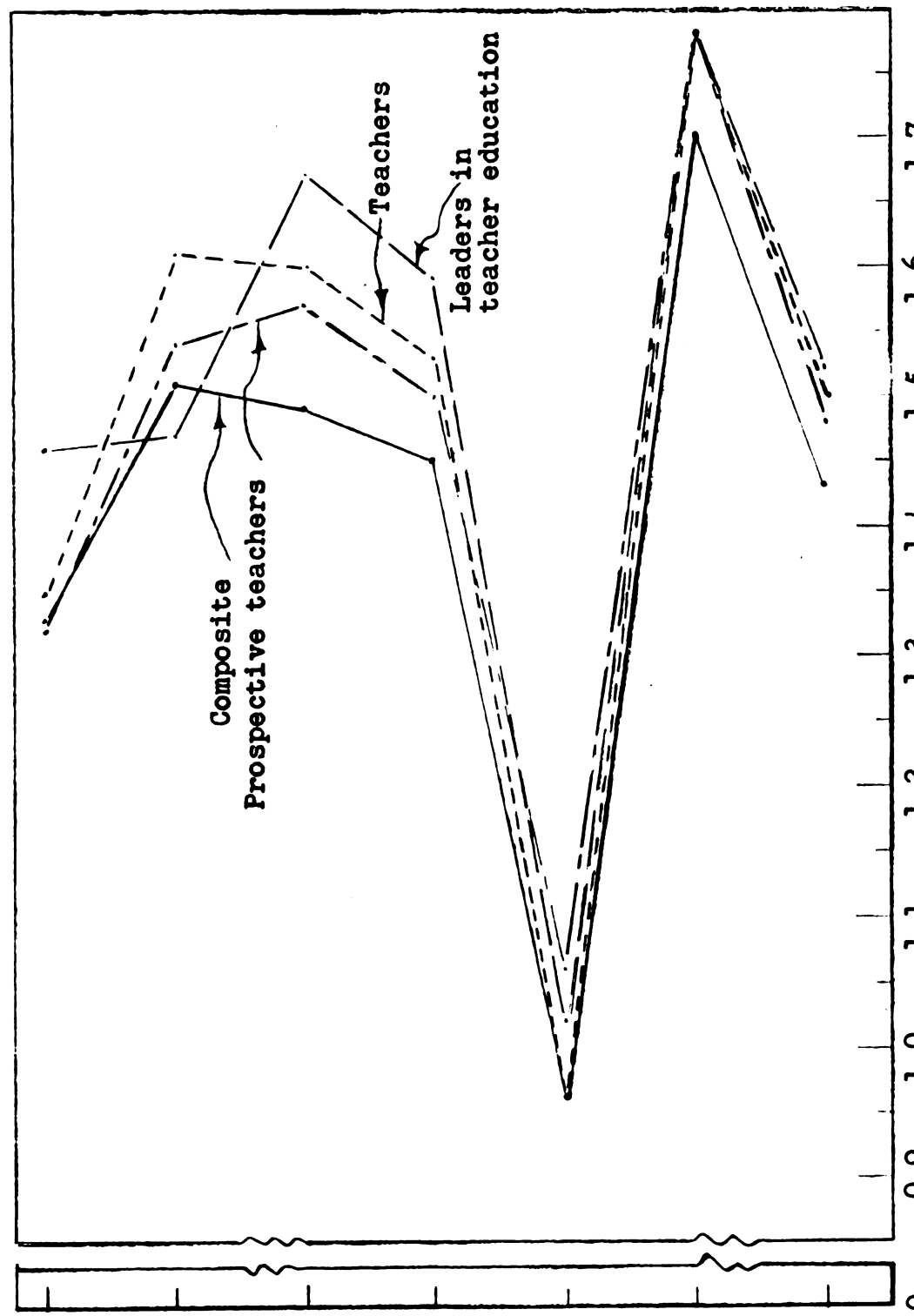


Fig. 4.--Comparison of the profiles of the ratings by leaders in teacher education, teachers of agriculture, prospective teachers and the composite. Data from Table 10.

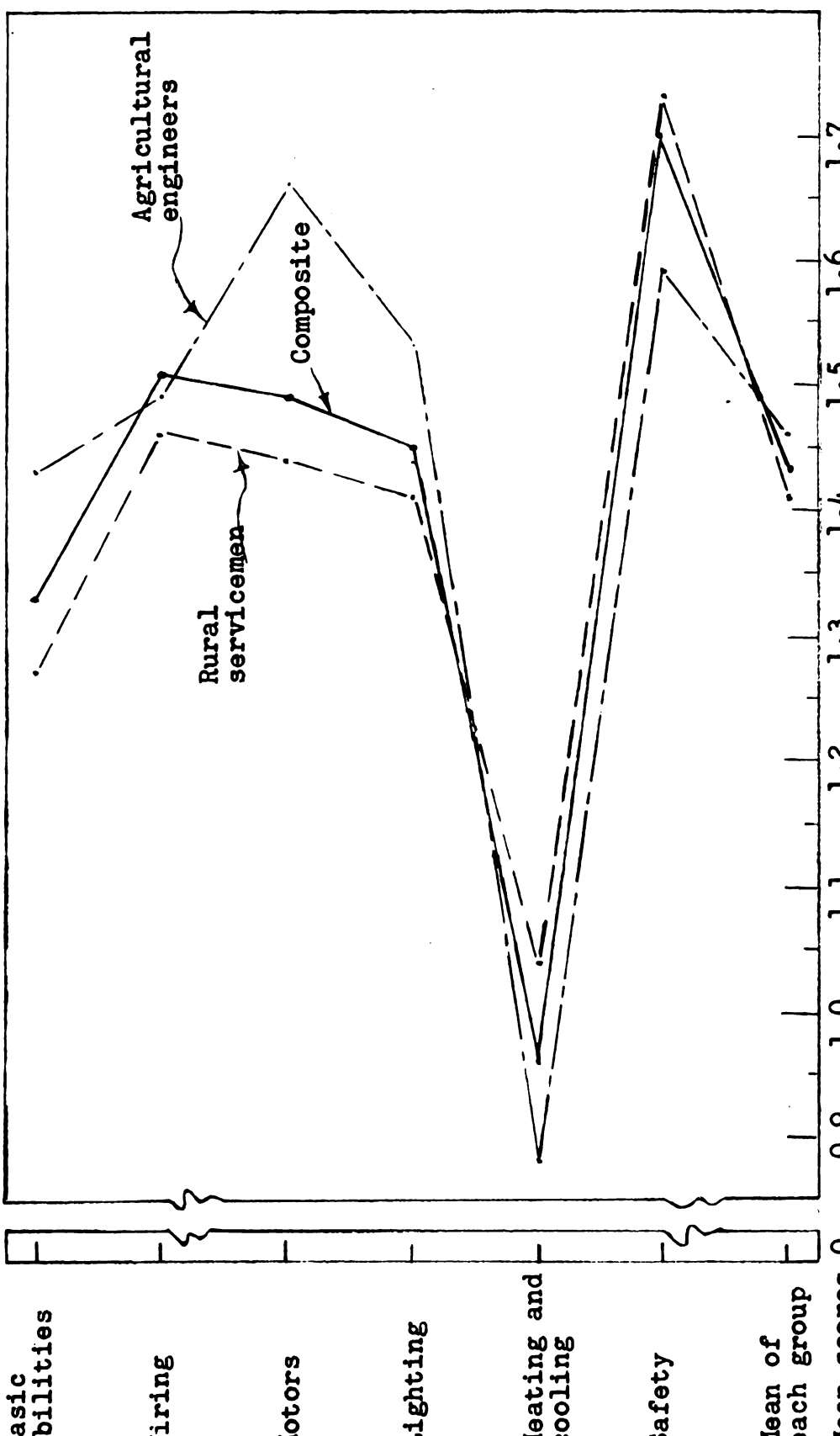


Fig. 5.--Comparison of the profiles of the mean scores of importance of the six sub-areas reported by agricultural engineers, rural servicemen and the composite. Data from Table 10.

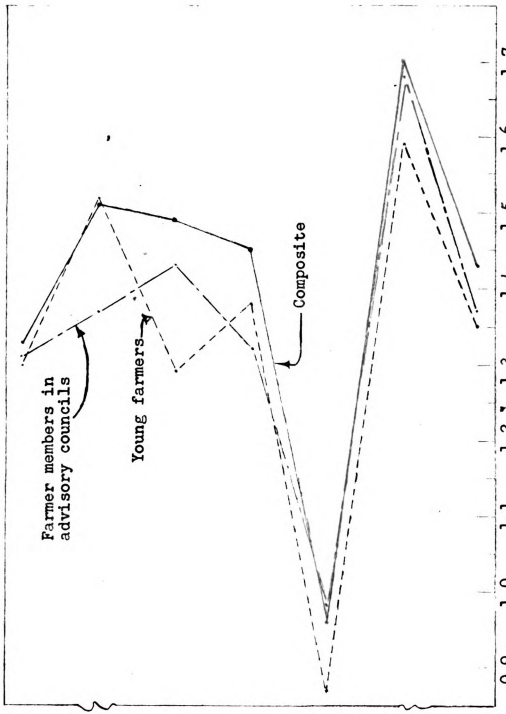


Fig. 6.--Comparison of the profiles of the mean scores of importance of six sub-areas as reported by farmers in advisory councils, young farmers and the composite in Michigan. Data from Table 10.

Similarly, the greater gaps between the composite and each of the three groups are shown in the sub-area motors. This reveals that the disagreement between the composite and each of the three groups in Fig. 4 is greater in the sub-area of motors than in other sub-areas.

Figure 5 compares the profiles of the ratings by agricultural engineers and rural servicemen with the composite. Heating and cooling is also the lowest sub-area. The profile of the ratings by the servicemen follows the composite profile more closely than does the profile of the ratings by the agricultural engineers.

Agricultural engineers rated the motors sub-area more important than safety. The gap between the agricultural engineers and the composite on the sub-area of safety is great. The greatest gap between the composite and the agricultural engineers is in the sub-area of motors. This indicates that the agricultural engineers rated sub-area motors much higher than all the groups except leaders in teacher education, and they rated safety lower than all groups except the young farmers. This is also shown in Table 10.

Figure 6 compares the profiles of the ratings by the farmer members of advisory councils, young farmers and the composite. Similar to Figs. 4 and 5, the sub-area heating and cooling ranks the least important in Fig. 6. The sub-area safety is also shown as the most important.

Young farmers rated the sub-area of motors very low,

as is shown in the largest gap between the young farmers and the composite in this sub-area. The farmer members also rated two sub-areas, wiring and lighting very low, as compared with the composite.

To sum up, from the three Figs. 4, 5, and 6, heating and cooling has been agreed upon by all groups as the least important sub-area. Safety has been considered by all but agricultural engineers as the most important sub-area. The greatest disagreement among the seven groups has been on the sub-area motors. All findings in the above substantiate the following comparison of ranks.

Rank order of the six sub-areas.--The composite rank order of the six sub-areas, as rated by seven groups, is presented in Table 11, as follows:

Rank	Sub-area
1.	Safety
2.	Wiring
3.	Motors
4.	Lighting
5.	Basic abilities
6.	Heating and cooling

Rank correlation.--Although there was unanimous agreement on the least important sub-area, heating and cooling, and all but one group agreed on the rank of safety and basic abilities, there was not complete agreement on the ranks of the remaining sub-groups. To plan the course

TABLE 11.--Ranks of importance of six sub-areas of rural electrification abilities reported by seven groups in Michigan. Data from Table 10.

Groups	Ranks of each of the six sub-areas						Ranks of all six sub-areas
	Basic abilities	Wiring	Motors	Lighting	Heating and Cooling	Safety	
State leaders in teacher education	5	4	2	3	6	1	1
Teachers of agriculture	5	2	3	4	6	1	2
Prospective teachers	5	3	2	4	6	1	3
Agricultural engineers	5	4	1	3	6	2	4
Rural servicemen	5	2	3	4	6	1	5
Farmer members of advisory councils	5	3	2	4	6	1	6
Young farmers	4	2	5	3	6	1	7
Composite	5	2	3	4	6	1	-

content, it seems quite reasonable to consider the sub-area heating and cooling as least important. But, the disagreement among the groups on the rank of the sub-areas motors and wiring suggests the need to analyze the data by means of rank correlation. It is intended to determine the degree of agreement among the composite and the seven groups. That is, to determine whether each group ranked the sub-areas independently (without any relationship with the rankings by other groups) or not. If the groups ranked the sub-areas independently, then there is no intercorrelation, otherwise there is.

Spearman rank[4] correlation was used to test the null hypothesis of independence.

Table 12 shows that the correlation coefficients of four paired groups have double asterisks, which means the correlation is significant at one per cent level. Therefore, the null hypothesis of independence is rejected in the following paired groups: (1) composite and teachers of agriculture, (2) composite and rural servicemen, (3) teachers of agriculture and rural servicemen, (4) prospective teachers and farmer members of advisory councils.

Similarly, there are 11 single asterisks, which indicates that the coefficients of the paired groups are significant at five per cent level. To these 11 paired

---

[4]Snedecor, op. cit., pp. 190-191.

TABLE 12.--Extent of agreement among the seven groups on the rank order of the six sub-areas indicated by inter-correlation coefficients.

Groups	Leaders in teacher education	Teachers of agriculture	Prospective teachers	Agricultural engineers	Rural servicemen	Farmers in advisory councils	Young farmers
Composite	0.83	1.00**	0.94*	0.71	1.00**	0.94*	0.83
Leaders in teacher education	-	0.83	0.94*	0.94*	0.83	0.94*	0.60
Teacher of agriculture		-	0.94*	0.71	1.00**	0.94*	0.83
Prospective teachers			-	0.89*	0.94*	1.00**	0.66
Agricultural engineers				-	0.71	0.89*	0.37
Rural servicemen					-	0.94*	0.83
Farmer members of advisory councils						-	0.66
Young farmers							-

*Significant at 5% level **Significant at 1% level

groups, the null hypothesis of independence can also be rejected at five per cent level. That is, chances are five times in a hundred that the statement "the seven groups ranked the six sub-areas independently" could be right.

All the other coefficients (without asterisks) are not significant at five per cent level. The null hypothesis of independence (or zero correlation in the population) cannot be rejected. None of the coefficients in young farmers' column is significant. Therefore, the null hypothesis that young farmers ranked the sub-areas independently from others cannot be rejected.

To sum up, there is partial agreement among the composite and the seven groups on the rank order of the six sub-areas.

The fact that the 47 teachers of agriculture ranked the six sub-areas the same as the composite is very important. This will be discussed in the comparison of the ratings between the composite and the 47 teachers later.

Rank order of the abilities within each of the six sub-areas

In determining the course content of rural electrification, all related abilities are grouped in sub-areas. Therefore, the abilities are arranged in order of importance in each of the following six sub-areas. Before listing these six sub-areas, an explanation of the method of finding the rank order within each sub-area as recorded in Appendices

A and I is needed.

To find rank order within each sub-area in Appendices A and I.--The mean score and rank of each ability within each of the six sub-areas as rated by the composite and the seven groups are recorded in Appendix I. Only the sub-area numbers I, II, III, . . . VI, and the abilities numbers 1, 2, 3, . . . are written in Appendix I. "I-1" stands for the number one ability in sub-area I. This ability is in the check-list of Appendix A. It is "Compute monthly bills from meter and rate schedule." The mean score of this ability rated by the leaders in teacher education is 1.37, which is the eighth highest score among the 12 abilities. Similarly "I-7" stands for ability number seven in sub-area I. "I-7" can be found in Appendix A as "Determine types and sizes of fuses for protection." The mean score of this "I-7" ability as rated by the teachers of agriculture is 1.91, which is the highest of the 12 abilities within this sub-area, therefore, it is the first in rank.

On the second page of Appendix I, the composite ranks of the 12 abilities within the sub-area I, basic abilities are recorded. Ability "I-7" is the highest rank, ability "I-8," the second rank, and ability "I-11," the 12th rank.

Rank of abilities within sub-area I, basic abilities.--The composite ranks of the 12 abilities within this sub-area and the ranks of these abilities among the 49 are:

Rank within sub-area I.	Abilities	Rank among 49 abilities
1.	Determine types and sizes of fuses for protection. (I-7)* (7)**	1
2.	Locate hazards such as short or open circuits. (I-8), (8)	6

*(I-7) is ability number seven of sub-area I. It is used here for convenience in finding the mean score and ranks in Appendices.

**(7) is ability seven listed in Appendix B. It is used here for checking the variation or deviations in Figs. 9, 10 and 11 in this chapter.

The above two abilities are in the first degree of importance, as was shown in Table 7. The greatest emphasis should be given to the above two abilities in the course content.

Rank within sub-area I.	Abilities	Rank among 49 abilities
3.	Repair damaged cords and make proper splices. (I-9) (9)	14.5
4.	Comply with electrical code and select Underwriters Laboratory approved materials. (I-6) (6)	16.5
5.	Select electrical appliances for convenience, economy and safety. (I-2) (2)	24
6.	Recognize sources of reliable information on rural electrification. (I-5) (5)	27
7.	Compare cost of electricity with other sources of power. (I-3) (3)	30

The above five abilities are in the second degree of importance among the 49 abilities.

Rank within sub-area I	Abilities	Rank among 49 abilities
8.	Compute energy consumption of various appliances (as: range, welder . . .) (I-4) (4)	39

The above ability is in the third degree of importance. All of the eight abilities in the first, second, and third degrees of importance are above the "fairly important" level.

9.	Compute monthly bills from meter and rate schedule (I-1) (1)	43
10.	Charge storage battery. (I-12), (12)	45
11.	Install time clock switch, thermostatic switch. (I-10) (10)	46

The above three abilities are in the fourth degree of importance. Their mean scores are near the "Fairly important" level.

12.	Install remote controls. (I-11), (11)	48

The above ability is in the least degree of importance. It is "relatively unimportant."

It is to be noted that the 12 abilities in sub-area I, basic abilities, are distributed in five degrees of importance. One ability "Determine types and sizes of fuses for protection," was ranked as the first in the 49 abilities, while the other ability, "Install remote control" was ranked the 48th. This indicates that to select course content, it is important to select the individual ability rather than to select the sub-area.

Rank order of abilities within sub-area II, wiring.--The composite ranks of the 10 abilities within the sub-area wiring are in Appendix I. The ranks within the sub-area and among the six sub-areas are as follows:

Rank within sub-area II.	Abilities	Rank among 49 abilities
1.	Plan wiring system for present and future loads. (II-1) (13)	10
2.	Select wiring material. (types, sizes, . . .) (II-3) (15)	12
3.	Use judgment to revise present wiring system. (II-10) (22)	20
4.	Wire a circuit for general purpose lights and outlets. (II-8) (20)	21
5.	Locate outlets and switches. (II-6) (18)	23
6.	Determine number of branch circuits in new buildings. (II-5) (17)	25

The above five abilities are in the second degree of importance.

7.	Locate load center and distribution center (II-2) (14)	31
8.	Select service entrance switches. (II-4) (16)	32
9.	Install 3-way and 4-way switches. (II-7) (19)	33
10.	Wire a circuit for special outlets. (as: range, welder . . .) (II-9) (21)	36.5

The above four abilities are in the third degree of importance. The abilities in the sub-area wiring are concentrated in the second and third degrees of importance. In comparison with the 12 abilities in the sub-area of basic

abilities, the abilities in the sub-area wiring are more homogeneous.

Rank order of abilities within sub-area III, motors.-- The mean scores and the composite ranks of the nine abilities of this sub-area are recorded in Appendix I. The rank order of the nine abilities within this sub-area and the ranks among the 49 are:

Rank within sub-area III.	Abilities	Rank among 49 abilities
1.	Select proper types and sizes of motors. (III-1) (21)	4

The above ability is in the first degree of importance. It is perhaps the only ability that is not related to safety. The prospective teachers ranked it the second; all other groups ranked it first in importance in this sub-area.

2.	Select proper overload protection. (III-2) (23)	11
3.	Interpret motor nameplate information. (III-7) (29)	13
4.	Select pulleys and belts for machine of desired speed. (III-8) (30)	14.5
5.	Clean and lubricate motors. (III-3) (25)	22
6.	Mount motor and adjust belt tension. (III-9) (31)	26

The above five abilities in the sub-area of motors are in the second degree of importance.

Rank within sub-area III. Motors	Abilities	Rank among 49 abilities
7.	Change direction of rotation of motor. (III-4) (26)	38
8.	Replace motor brushes. (III-6) (28)	40
9.	Change voltage of dual voltage motor. (III-5) (27)	41

The above three abilities are in the third degree of importance. Since all the abilities in this sub-area are above the fourth degree of importance, none of them are in the "fairly important" level. All of the abilities in this sub-area are needed by the teachers, as the rating shows.

Rank order of abilities within sub-area IV, lighting.--The composite mean scores and ranks of this sub-area are recorded in Appendix I. All the five abilities in this sub-area are in the second and third degrees of importance. All of them are above the "fairly important" level. The composite ranks within the sub-area and the ranks among the 49 abilities are:

Rank within sub-area IV. Lighting	Abilities	Rank among 49 abilities
1.	Recognize effects of poor lighting in quantity and quality. (IV-1) (32)	16.5
2.	Select lighting equipment for home and yards. (IV-4) (35)	28
3.	Determine light requirements for various areas and jobs. (IV-2) (35)	29

The above three abilities are in the second degree of importance.

Rank within sub-area IV. Lighting	Abilities	Rank among 49 abilities
4.	Install light fixtures. (IV-5) (36)	34
5.	Determine voltage drop and its effect on lighting. (IV-3) (34)	36.5

The above two abilities are in the third degree of importance. All the abilities in this sub-area are quite homogeneous in importance, as rated by the 216 respondents.

Rank order of abilities within sub-area V, heating and cooling.--The composite ranks of the five abilities within this sub-area and their ranks among the 49 are:

Rank within sub-area V. Heating & cooling	Abilities	Rank among 49 abilities
1.	Install heat lamps for pig or chicken brooding. (V-1) (37)	19

The above ability is in the second degree of importance. It was stated previously that heating and cooling is the least important of the six sub-areas. However, this ability ranked 19th and therefore must be considered important. This is another instance indicating that the selecting of individual abilities rather than the sub-area is essential in determining the course content.

2.	Determine water requirements in gallons per hour for home and farmstead (V-4) (40)	42
3.	Determine cost of heating home with electricity. (V-2) (38)	44

The above two abilities are in the fourth degree of importance. They are near the "fairly important" level.

It may be that the above two abilities are not very practical on most of the farms, and therefore the respondents rated them very low.

Rank within sub-area V. Heating & cooling	Abilities	Rank among 49 abilities
4.	Calculate heat in BTU which must be removed to cool farm products. (V-3) (39)	47
5.	Install air conditioner at home. (V-5) (41)	49

The above two abilities are in the least degree of importance. They are in the relatively unimportant level. These two abilities do not seem to be very practical, because not many farmers in Michigan calculate heat in BTU, nor use air conditioners.

Except for the ability "Install heat lamp for pig or chicken brooding," the other four abilities in this sub-area are either fairly important or not important for preparation of Michigan teachers of agriculture.

Rank order of abilities within sub-area VI, safety.--The composite mean scores and ranks of the eight abilities within this sub-area are in Appendix I. The two kinds of ranks of the eight abilities within this sub-area are:

Rank Within sub-area VI, safety	Abilities	Rank among 49 abilities
1.	Ground equipment and wiring system safely. (VI-1) (42)	2
2.	Recognize hazards of substandard wiring. (VI-6) (47)	3
3.	Prevent electric shock. (VI-4) (45)	5

The above three abilities are in the first degree of importance. It was pointed out that safety abilities were rated of the greatest importance.

Rank within sub-area VI, safety	Abilities	Rank among 49 abilities
4.	Install fire-proof lighting fixture in hayloft properly. (VI-3) (44)	7
5.	Use fire fighting equipment for electric fires. (VI-5) (46)	8
6.	Make electric fence controller safe. (VI-2) (43)	9
7.	Protect buildings from hazards of lightning. (VI-7) (48)	18

The above four abilities are in the second degree of importance. The first three of the above four abilities are the first nine highest ranking abilities. Their mean scores are over 1.72, which is very close to 1.76, the mean score of the first degree of importance.

8.	Use ultraviolet lamp and other special lamps safely. (VI-8) (49)	35

The above ability is in the third degree of importance. This is the only ability in the sub-area safety that is below the average in mean score and rank, all the other seven abilities are very high in ranks and mean scores.

To sum up, the 12 abilities in sub-area basic abilities are distributed in the five degrees (or levels) of importance. Some of the abilities are very important and should be in the course content. Some abilities are fairly important or unimportant and are not needed. The distribution

of the abilities of each sub-area is in Table 13.

TABLE 13.--Distribution of abilities of each of the six sub-areas in the five degrees (or levels) of importance.

Sub-area	Degree of importance				
	First	Second	Third	Fourth	Fifth
I. Basic abilities	7*, 8	9, 6, 2, 5, 3	4	1, 12, 10	11
II. Wiring		1, 3, 10, 8, 6, 5	2, 4, 7, 9		
III. Motors	1	2, 7, 8, 3, 9	4, 6, 5		
IV. Lighting		1, 4, 2	5, 3		
V. Heating and cooling		1		4, 2	3, 5
VI. Safety	1, 6, 4	3, 5, 2, 7	8		
Total	6	24	11	5	3

*7 indicates ability I-7, "Determine types and sizes of fuses for protection." See Appendix A or B, the check-list.

As shown in Table 13, all the abilities in the sub-areas of wiring, motors, lighting and safety are in the first three degrees of importance. They are all above "Fairly important" level, and all should be included in the course content.

Only one ability in the sub-area of heating and

cooling is in the second degree of importance and it should be in the course. The other four abilities are either fairly important or relatively unimportant, and may be included as optional in the course or not needed.

Rank of the seven groups on their ratings of importance

Table 14 shows the composite and each of the seven group means. The composite mean is 1.43, which is the grand mean of the 49 abilities rated by the 216 respondents. The deviation of each group mean from the composite mean reveals that the leaders of teacher education group has the highest mean, and the young farmers' group the lowest mean. The latter mean is 0.08 below the composite mean, while the former is 0.09 above the composite mean.

The first four groups in Table 14 are all above the composite mean. They are all related to the profession of teaching. The last three groups have their means below the composite. They are not in the profession of teaching.

It was discussed in the previous chapters that the evaluation by a composite of many groups which are closely associated with the rural electrification education would be more representative than the evaluation by any one group. In order to determine whether the teachers of agriculture rated differently from the composite and other groups, it is necessary to determine the significance of the differences among the group means.

TABLE 14.--Extent of group agreement indicated by the mean scores of importance of all abilities as rated by seven groups of respondents in Michigan.

	Mean score of all (49) abilities	Deviation from composite
Leaders in teacher education	1.52	+0.09
Teachers of agriculture	1.50	+0.07
Prospective teachers	1.48	+0.05
Agricultural engineers	1.46	+0.03
Rural servicemen	1.41	-0.02
Farmer members of advisory councils	1.37	-0.06
Young farmers	1.35	-0.08
Composite	1.43	--

Data from Appendix I, pp. 198.

Analysis of variance--To test the significance of the differences of the means among the groups, analysis of variance, shown in Table 15, was carried out.[5]

The ratio of the mean squares among the seven groups and within each of the seven groups is 2.436. An F-table at six and 209 degrees of freedom shows that an F-value

[5]Snedecor, op. cit., pp. 240-269.

TABLE 15.--Analysis of variance of the mean score of importance of 49 abilities in rural electrification as reported by seven groups of respondents.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratio
Among groups	6	0.8715	0.1452	2.436*
Within each group	209	12.4543	0.0596	
Total	215	13.3258		

*Significant, $p < 0.025$

$F_{6,209}$ at 0.05 = $F \geq 2.10$; $F_{6,209}$ at 0.025 = $F \geq 2.41$

$F_{6,209}$ at 0.01 = $F \geq 2.80$

2.10 must be equalled or exceeded to be significant at five per cent level. Therefore the differences among the group means are significant at the five per cent level. The null hypothesis, that the disagreement among the seven groups on their rating of the importance of all abilities is insignificant, is thus rejected.

Duncan's Multiple Range and Multiple F Test.--To determine whether or not each group mean is significantly different from the other means, Duncan's method,[6] as shown

[6] Duncan, loc. cit.

in Fig. 7, was applied. The seven group means; 1.35, 1.37, . . . 1.52 of young farmers, farmer members of advisory councils, up to leaders in teacher education are arranged in order of importance. There are three lines, A, B and C under the seven group means. Line A is under the means of the following five groups: (1) rural servicemen, agricultural engineers, prospective teachers, teachers of agriculture and leaders of teacher education. This indicates that the differences among the group means of the above five groups are insignificant.

Line B is under the five means of another five groups, namely: farmer members of advisory councils, rural servicemen, agricultural engineers, prospective teachers and teachers of agriculture. Line B shows that the five groups which are directly over it have no significant differences among their means.

Similarly, Line C symbolizes that the differences of the means among the following five groups are insignificant: young farmers, farmer members of advisory councils, rural servicemen, agricultural engineers and prospective teachers.

Group means with significant differences.--The differences of the means of the following groups are significant at the five per cent level:

(1) Young farmers and teachers of agriculture, (no common line underlined the means of these two groups).

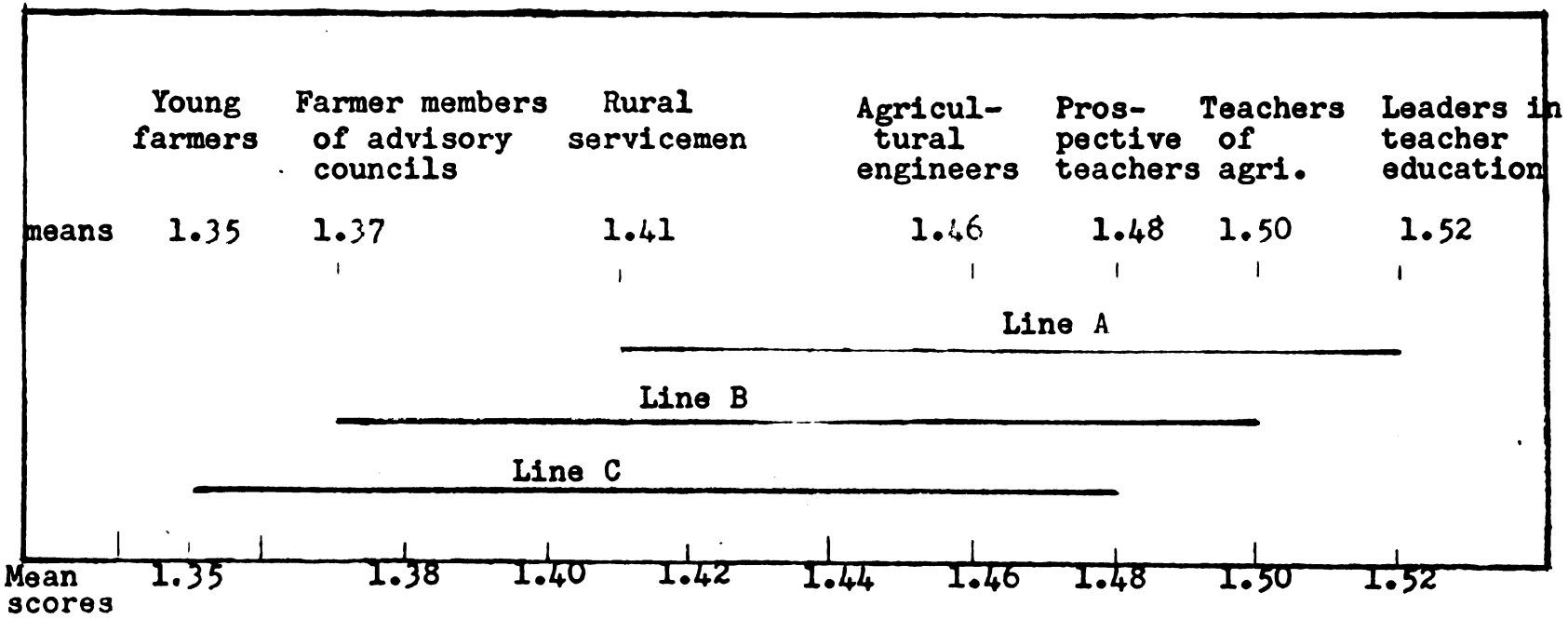


Fig. 7.--Comparison of the significance of the means of the seven groups.

(2) Young farmers and leaders in teacher education, (these two groups have no common line directly under them).

(3) Farmer members of advisory councils and leaders in teacher education, (no common line reaches the means or directly under these two groups).

Thus, the leaders in teacher education and the teachers of agriculture rated the 49 abilities more important than the two farmers' groups.

The Evaluation of Importance, Training and Application of 49 Abilities by 47 Teachers

The 47 teachers of agriculture, not only reported the importance of the 49 abilities, as the other six groups have done, but also rated the adequacy of training and the frequency of their application of these abilities in teaching high school students or farmers in their local schools.

One of the objectives of this section is to find the rank order of the 49 abilities as rated by the 47 teachers according to (1) the degree of importance, (2) adequacy of training, and (3) the frequency of application.

The three kinds of rank order are to be presented as follows:

Rank order of importance rated by 47 teachers

The rank order of importance of the 49 abilities as rated by the 47 teachers of agriculture is arranged in

Table 24. The highest mean score of importance is 1.91. Four abilities, as shown in Table 16, have mean score of 1.91. The lowest mean score is 0.51.

The group mean score (that is, the total mean score of the 49 abilities rated by 47 teachers) is 1.50. Since a score of 2.00, as used in the present study, indicates "very important," and 1.00 indicates "fairly important," the group mean score of importance 1.50, is mid-way between "very important" and "fairly important." Thus, as a whole, the teachers of agriculture rated the 49 abilities very high.

Twenty-eight of 49 abilities, or 57.2 per cent, have mean scores greater than 1.50. Seventeen of 49, or 34.7 per cent of 49 abilities have mean scores between 1.00 and 1.50. Only four abilities, or 8.1 per cent of the total 49, have mean scores below 1.00, or "fairly important" level. This also indicates that a great majority of the abilities were rated important by the 47 teachers.

Abilities with very high ranks.--Five abilities in the sub-area safety are among the first 10 highest ranks. Other abilities such as "Determine types and sizes of fuses for protection," "Repair damaged cords and make proper splices," "Locate hazards . . ." are also related to safety.

The 47 teachers ranked abilities related to safety very high. Their rating is very similar to that of the composite in this respect; although slight variation, as

TABLE 16.--Rank order of mean scores of importance of 49 abilities in rural electrification rated by 47 teachers of agriculture in Michigan, 1959.

Ability	Mean score of importance	Rank
I. First Degree in Importance (Mean score above $\bar{X}$+s)		
Determine types and sizes of fuses for protection (I-7)*	1.91	2.5
Select proper types and sizes of motors (III-1)	1.91	2.5
Install heat lamps for pig or chicken brooding (V-1)	1.91	2.5
Recognize hazards of sub-standard wiring (VI-6)	1.91	2.5
Ground equipment and wiring system safely (VI-1)	1.89	5.5
Make electric fence controller safe (VI-2)	1.89	5.5
II. Second Degree in Importance (Mean score from $\bar{X}$ to $\bar{X}$+s)		
Repair damaged cords and make proper splices (I-9)	1.87	7.5
Use fire fighting equipment for electric fires (VI-5)	1.87	7.5
Locate hazards such as short or open circuits (I-8)	1.85	9.5
Protect buildings from hazards of lightning (VI-7)	1.85	9.5

*(I-7) . . . means sub-area I, ability number 7, see Appendix A check-list.

TABLE 16 - Continued

Ability	Mean score of importance	Rank
Interpret motor nameplate information (III-7)	1.83	11
Install fire-proof lighting fixture in hayloft properly (VI-3)	1.81	12
Wire a circuit for general purpose lights and outlets (II-8)	1.79	14
Select proper overload protection (III-2)	1.79	14
Clean and lubricate motors (III-3)	1.79	14
Select wiring materials (types, sizes, . . .) (II-3)	1.77	16.5
Select pulleys and belts for machine of desired speed (III-8)	1.77	16.5
Comply with electrical code and select Underwriters Laboratory approved materials (I-6)	1.74	18.5
Prevent electric shock (VI-4)	1.74	18.5
Locate outlets and switches (II-6)	1.72	20.5
Install 3-way and 4-way switches (II-7)	1.72	20.5
Use judgement to revise present wiring system (II-10)	1.64	22.5
Install light fixtures (IV-5)	1.64	22.5
Plan wiring system for present and future loads (II-1)	1.62	24
Determine number of branch circuits in new buildings (II-5)	1.60	26
Mount motor and adjust belt tension (III-9)	1.60	26

TABLE 16 - Continued

Ability	Mean score of importance	Rank
Recognize effects of poor lighting in quantity and quality (IV-1)	1.60	26
Select lighting equipment for home and yards (IV-4)	1.51	28
III. Third Degree of Importance (Mean score from $\bar{X}$-s to $\bar{X}$)		
Select service-entrance switches (II-4)	1.49	29.5
Determine voltage drop and its effect on lighting (IV-3)	1.49	29.5
Recognize sources of reliable information on rural electrification (I-5)	1.47	31.5
Wire a circuit for special outlets (as range, welder . . .) (II-9)	1.47	31.5
Determine light requirements for various areas and jobs (IV-2)	1.40	33
Replace motor brushes (III-6)	1.38	34
Locate load center and distribution center (II-2)	1.34	35
Compare cost of electricity with other sources of power (I-3)	1.30	36.5
Change direction of rotation of motor (III-4)	1.30	36.5
Select electrical appliances for convenience, economy and safety (I-2)	1.28	38
Use ultraviolet lamp and other special lamp safely (VI-8)	1.26	39
Compute energy consumption of various appliances (as: range, welder . . .) (I-4)	1.17	40

TABLE 16 - Continued

Ability	Mean score of importance	Rank
IV. Fourth Degree of Importance (Mean score from $\bar{X}$-s to $\bar{X}$-2s)		
Determine water requirements in gallons per hour for home and farmstead (V-4)	1.09	41
Change voltage of dual voltage motor (III-5)	1.06	42
Compute monthly bills from meter and rate schedule (I-1)	1.00	44
Install time clock switch, thermostatic switch (I-10)	1.00	44
Change storage battery (I-12)	1.00	44
V. Least Degree of Importance (Mean score below $\bar{X}$-2s)		
Determine cost of heating home with electricity (V-2)	0.72	46
Install remote control (I-11)	0.57	47.5
Calculate heat in BTU which must be removed to cool farm products (V-3)	0.57	47.5
Install air conditioner at home (V-5)	0.51	49

in the following two abilities, also occurred.

The 47 teachers did not rank "prevent electric shock" as high as the composite. Teachers ranked it 18.5, while the composite ranked it fifth. Although the difference between the two mean scores is less than 0.04, the difference in rank is more than 13.5. In fact, the teachers'

rank on this ability is the lowest among the seven groups. (See ability VI-4 in Appendix I.) The teachers of agriculture may need to recognize the importance that the other six groups have given to this ability.

The ability "Install heat lamps for pig or chicken brooding" is ranked as one of the highest by these teachers. The composite group ranked it 19th. The mean score rated by the teachers is 1.91, which is 0.43 points over 1.58. The teachers rated this ability much higher than the composite. Although heating and cooling has been regarded as the least important sub-area by all groups, yet this ability was ranked by composite in the second degree of importance level, and was ranked as one of the first by the 47 teachers. This reveals that in the planning of course content, the selection of individual abilities is very important.

As will be discussed later, the ability "Install heat lamps for pig or chicken brooding," ranked sixth in adequacy of training and first in application. It may be that the teachers rated it high because of its applicability. It appears to be a very practical useful ability. It may be used as a good project or demonstration.

Abilities with very low ranks.--The mean scores of the four lowest ranking abilities are less than 0.73. These abilities are "relatively unimportant," as has been defined in the present study. Three of these four abilities are in

the heating and cooling sub-area.

All but one of the nine abilities with the lowest ranks belong to either sub-area I, basic abilities, or sub-area V, heating and cooling. The composite also ranked these abilities the lowest. The teachers and the composite ranked the least important abilities in a similar order.

Thus, the composite and the teachers rated most of the abilities in the highest and the lowest ranks in a similar way, despite some variations with a few abilities.

In the selection of abilities for course content, the individual ability as well as the sub-area should be considered. This is indicated in the data, since one of the five abilities in the heating and cooling sub-area was ranked first and four other abilities in the same sub-area were ranked among the nine lowest by the same group of teachers.

Degree of importance of 49 abilities.--To determine the degree of importance of the 49 abilities, all of them are divided into five intervals or levels. As indicated in Table 17, the division is based on the group mean $\bar{X}$, which is 1.50, and the standard deviation s, which is 0.39.

Six abilities, with mean scores over 1.89, (or above $\bar{X}+x$), are of the first degree of importance. These most important abilities, ranking from the first to the sixth, carry about 12.2 per cent of the total of 49 abilities.

Twenty-two mean scores, or about 45 per cent of the

TABLE 17.--Distribution of mean score of importance of 49 abilities in rural electrification reported by 47 teachers of agriculture in Michigan, 1959

Interval	Deviation from grand mean, $\bar{X}$	Frequency	Per cent	Degree of importance	Rank order
1.89-2.27	$\bar{X}$+x to $\bar{X}$+2s	6	12.24	First	1-6
1.50-1.89	$\bar{X}$ to $\bar{X}$+s	22	44.91	Second	7-28
1.11-1.50	$\bar{X}$-s to $\bar{X}$	12	24.49	Third	29-40
0.73-1.11	$\bar{X}$-2s to $\bar{X}$-s	5	10.20	Fourth	41-45
0.34-0.73	$\bar{X}$-3s to $\bar{X}$-2s	4	8.16	Least	46-49
Total		49	100.00		1-49

Data from Table 16.

49 abilities are above 1.50. This shows that the teachers rated many abilities quite high, since more than 57 per cent of abilities are over 1.50.

Four mean scores, or about eight per cent of 49 abilities, are below 1.00. Only these four abilities are "relatively unimportant."

Rank order of adequacy of training by 47 teachers

The rank order of adequacy of training of the 49 abilities as rated by the 47 teachers of agriculture is arranged in Table 18. The highest and the lowest mean scores are 1.64 and 0.19 respectively.

The group mean on training is 1.03, which indicates that the teachers with a mean score of 1.50 rated the importance higher. Comparing the mean scores in the Tables 16 and 18, almost all the training scores are lower than the importance scores as rated by the same group of teachers.

Since the group mean score on training is 1.03, the over-all training of the 49 abilities is in the "fairly adequate" level.

Distribution of the mean scores of training.--Only one of the 49 abilities was rated 1.50 in mean score. Twenty-nine of the 49 mean scores are equal or above 1.00, but below 1.50. Nineteen of the 49 mean scores are below 1.00. Therefore, according to these teachers' evaluations, they did not have sufficient training on many of the abilities.

Abilities with very high ranks.--The following abilities that ranked very high in importance, are also ranked high in training:

(a) Install heat lamps for pig or chicken brooding. (V-1)

(b) Determine types and sizes of fuses for protection. (I-7)

(c) Repair damaged cords and make proper splices. (I-9)

(d) Interpret motor nameplate information. (III-7)

There is only one of the 49 abilities in which the training mean score is greater than its importance mean score.

TABLE 18.--Rank order of mean scores of training of the 49 abilities in rural electrification rated by 47 teachers of agriculture in Michigan, 1959.

Ability	Mean score of training	Rank
I. First Degree of Training (Mean score above $\bar{X}+s$)		
Repair damaged cords and make proper splices (I-9)*	1.64	1
Wire a circuit for general purpose lights and outlets (II-8)	1.49	2
Determine types and sizes of fuses for protection (I-7)	1.47	3
Compute monthly bills from meter and rate schedule (I-1)	1.38	4.5
Install 3-way and 4-way switches (II-7)	1.38	4.5
II. Second Degree of Training (Mean score from $\bar{X}$ to $\bar{X}+s$)		
Install heat lamps for pig or chicken brooding (V-1)	1.36	6
Interpret motor nameplate information (III-7)	1.34	7
Select wiring materials (types, sizes, . . .) (II-3)	1.32	8
Locate outlets and switches (II-6)	1.28	10
Install light fixtures (IV-5)	1.28	10
Comply with electrical code and select Underwriters Laboratory approved materials (I-6)	1.28	10
Locate hazards such as short or open circuits (I-8)	1.26	12

*(I-9) . . . sub-area I, ability number 9.

TABLE 18 - Continued

Ability	Mean score of training	Rank
Plan wiring system for present and future loads (II-1)	1.23	14
Select pulleys and belts for machine of desired speed (III-8)	1.23	14
Mount motor and adjust belt tension (III-9)	1.23	14
Clean and lubricate motor (III-3)	1.19	16.5
Recognize hazards of substandard wiring (VI-6)	1.19	16.5
Compute energy consumption of various appliances (as: range, welder, . . .) (I-4)	1.17	18
Select proper types and sizes of motors (III-1)	1.15	19.5
Ground equipment and wiring system safely (VI-1)	1.15	19.5
Recognize sources of reliable information on rural electrification (I-5)	1.11	22.5
Determine number of branch circuits in new buildings (II-5)	1.11	22.5
Determine voltage drop and its effect on lighting (IV-3)	1.11	22.5
Install fire-proof lighting fixture in hayloft properly (VI-3)	1.11	22.5
Select proper overload protection (III-2)	1.09	25.5
Prevent electric shock (VI-4)	1.09	25.5

TABLE 18 - Continued

Ability	Mean score of training	Rank
III. Third Degree of Training (Mean score from $\bar{X}$-s to $\bar{X}$)		
Wire a circuit for special outlet (as: range, welder, . . .) (II-9)	1.04	27
Select lighting equipment for home and yards (IV-4)	1.02	28.5
Protect buildings from hazards of lighting (VI-7)	1.02	28.5
Recognize effects of poor lighting in quantity and quality (IV-1)	1.00	30
Compare cost of electricity with other sources of power (I-3)	0.98	32
Locate load center and distribution center (II-2)	0.98	32
Select service-entrance switches (II-4)	0.98	32
Use judgment to revise present wiring system (II-10)	0.94	35
Change direction of rotation of motor (III-4)	0.94	35
Use fire fighting equipment for electric fires (VI-5)	0.94	35
Make electric fence controller safe (VI-2)	0.92	37
Select electrical appliances for convenience, economy and safety (I-2)	0.87	38
Replace motor brushes (III-6)	0.83	39
Determine light requirements for various areas and jobs (IV-2)	0.79	40

TABLE 18 - Continued

Ability	Mean score of training	Rank
IV. Fourth Degree of Training (Mean score from $\bar{X}$-2s to $\bar{X}$-s)		
Change storage battery (I-12)	0.75	41
Use ultraviolet lamp and other special lamps safely (VI-8)	0.70	42
Determine cost of heating home with electricity (V-2)	0.68	43
Change voltage of dual voltage motor (III-5)	0.64	44
Determine water requirements in gallons per hour for home and farmstead (V-4)	0.62	45
Install time clock switch, thermostatic switch (I-10)	0.57	46
V. Least Degree of Training (Mean score below $\bar{X}$-2s)		
Calculate heat in BTU which must be removed to cool farm products (V-3)	0.34	47
Install remote controls (I-11)	0.32	48
Install air conditioner at home (V-5)	0.19	49

This ability is "Compute monthly bills from meter and rate schedule (I-1)." The training score is 0.38 points greater than the importance mean score. It is ranked 4.5 in training but 44th in importance, the difference in rank is 39.5.

Most of the abilities with high ranks in training are in the sub-area I, basic abilities, and sub-area II, wiring.

Five of the abilities in the sub-area safety were ranked high in importance, but not in training. The comparison will be discussed later in this chapter. Suffice it to say that much more training is needed with abilities related to safety.

Abilities with very low ranks.--The mean score of the nine abilities with the lowest ranks are less than 0.76. The training on these abilities is not sufficient. Four of the nine abilities are in the heating and cooling sub-area. These nine abilities were rated relatively unimportant and were placed in the lowest ranks. Therefore, abilities rated by the teachers as "inadequate training" are also rated as "relatively unimportant." There is more similarity in the ranks of importance and training at the very low ranking level than at the very high level.

Degree (or level) of training of the 49 abilities.--To differentiate the adequacy of the training received by the teachers in each ability, all mean scores are divided into five intervals (or levels) of training as shown in Table 19. The division is based on the group mean of the training score $\bar{X}$, which is 1.03, and its standard deviation s, which is 0.33.

Five abilities are in the first level of training. The mean scores of these abilities are above 1.36, $(\bar{X}+s)$. The ranks of these abilities are from the first to the fifth.

Twenty-one abilities, with mean scores from 1.03 to

TABLE 19.--Distribution of mean scores of training of 49 abilities in rural electrification reported by 47 teachers of agriculture in Michigan, 1959.

Interval	Deviation from grand mean, $\bar{X}$	Frequency	Per cent	Level of training	Rank order
1.36-1.69	$\bar{X}$+s to $\bar{X}$+2s	5	10.2	First	1-5
1.03-1.36	$\bar{X}$ to $\bar{X}$+s	21	42.8	Second	6-26
0.70-1.03	$\bar{X}$-s to $\bar{X}$	14	28.6	Third	27-40
0.37-0.70	$\bar{X}$-2s to $\bar{X}$-s	6	12.3	Fourth	41-46
0.04-0.37	$\bar{X}$-3x to $\bar{X}$-2s	3	6.1	Least	47-49
Total		49	100		1-49

Data from Table 18.

1.36, (or $\bar{X}$ to $\bar{X}$+s), are in the second level of training. These 21 abilities ranking from the sixth to 26th, carry 42.8 per cent of the 49 abilities.

Fourteen of the 49 abilities, or 28.6 per cent of them, are in the second level of training. More than 71 per cent of the abilities are concentrated in the second and third levels of training.

Rank order of frequency of application by 47 teachers

The rank order based on the frequency of teaching each ability by high school teachers is arranged in Table 20. The highest and the lowest mean scores are 1.92 and 0.09 respectively. The range is 1.83, which is the greatest

of the three as rated by the same group. (Range for importance and training mean scores are 1.40 and 1.45 respectively.)

The standard deviation of the mean scores of application is 0.48, which is greater than the other standard deviations (s for importance is 0.39, s for training is 0.33). Therefore, there seems to be more variation in application among the 49 abilities, despite the fact that the three ratings were by the same group.

The mean score for application of the total 49 abilities is 1.23, which is between 1.50, the group mean of importance, and 1.03, the group mean of training.

Abilities with very high ranks--Nine of the abilities with the highest ranks in application as shown in Table 20 are found also in the first 10 ranks either in Table 16 or Table 18. This indicates that abilities with very high ranks in application appear to be related to the importance and training. The ability "Install heat lamps for pig or chicken brooding," was the most frequently taught by the 47 teachers. It is also ranked as one of the highest in importance. The training in this ability, as indicated in Table 18, is ranked sixth. The mean score of training is 1.36, which is smaller than the mean score of importance, 1.91. It is also smaller than the mean score of application, 1.92. It appears that the training on this ability is not matched with its importance and application.

TABLE 20.--Rank order of mean scores of application of 49 abilities in rural electrification rated by 47 teachers of agriculture in Michigan, 1959.

Ability	Mean score of application	Rank
I. First Degree of Application (Mean score above $\bar{X}+s$)		
Install heat lamps for pig or chicken brooding (V-1)*	1.92	1
Select wiring materials (types, sizes, . . .) (II-3)	1.87	2
Determine types and sizes of fuses for protection (I-7)	1.83	3.5
Repair damaged cords and make proper splices (I-9)	1.83	3.5
Wire a circuit for general purpose lights and outlets (II-8)	1.79	5.5
Recognize hazards of substandard wiring (VI-6)	1.79	5.5
Interpret motor nameplate information (III-7)	1.75	7
II. Second Degree of Application (Mean score from $\bar{X}$ to $\bar{X}+s$)		
Mount motor and adjust belt tension (III-9)	1.70	9.5
Install light fixtures (IV-5)	1.70	9.5
Ground equipment and wiring system safely (VI-1)	1.70	9.5
Locate outlets and switches (II-6)	1.70	9.5

*(V-1) . . . See Appendix A, check-list, sub-area V, ability number one.

TABLE 20 - Continued

Ability	Mean score of application	Rank
Comply with electric code and select Underwriters Laboratory approved materials (I-6)	1.62	12
Select pulleys and belts for machine of desired speed (III-8)	1.58	13
Install 3-way and 4-way switches (II-7)	1.53	14.5
Clean and lubricate motors (III-3)	1.53	14.5
Plan wiring system for present and future loads (II-1)	1.49	16.5
Select proper types and sizes of motors (III-1)	1.49	16.5
Prevent electric shock (VI-4)	1.40	20
Protect buildings from hazards of lightning (VI-7)	1.40	20
Compare cost of electricity with other sources of power (I-3)	1.40	20
Select service-entrance switches (II-4)	1.40	20
Locate hazards such as short or open circuits (I-8)	1.40	20
Compute monthly bills from meter and rate schedule (I-1)	1.36	23
Select electrical appliances for convenience, economy and safety (I-2)	1.32	25
Select lighting equipment for home and yards (IV-4)	1.32	25
Use fire fighting equipment for electric fires (VI-5)	1.32	25

TABLE 20 - Continued

Ability	Mean score of application	Rank
Compute energy consumption of various appliances (as: range, welders, . . .) (I-4)	1.28	27.5
Determine number of branch circuits in new buildings (II-5)	1.28	27.5
Use judgment to revise present wiring system (II-10)	1.23	29
III. Third Degree of Application (Mean score from $\bar{X}$-s to $\bar{X}$)		
Select proper overload protection (III-2)	1.19	31.5
Change direction of rotation of motor (III-4)	1.19	31.5
Recognize effects of poor lighting in quantity and quality (IV-1)	1.19	31.5
Wire a circuit for special outlets (as: range, welder, . . .) (II-9)	1.19	31.5
Recognize sources of reliable information on rural electrification (I-5)	1.15	34
Locate load center and distribution center (II-2)	1.11	35
Make electric fence controller safe (VI-2)	1.06	36
Replace motor brushes (III-6)	1.02	37.5
Determine voltage drop and its effect on lighting (IV-3)	1.02	37.5
Install fire-proof lighting fixture in hayloft properly (VI-3)	0.98	39
Charge storage battery (I-12)	0.85	40

TABLE 20 - Continued

Ability	Mean score of application	Rank
IV. Fourth Degree of Application (Mean score from $\bar{X}$-s to $\bar{X}$-2s)		
Use ultraviolet lamp and other special lamps safely (VI-8)	0.60	41.5
Determine light requirements for areas and jobs (IV-2)	0.60	41.5
Change voltage of dual voltage motor (III-5)	0.55	43
Install time clock switch, thermostatic switch (I-10)	0.43	44
Determine water requirements in gallons per hour for home and farmstead (V-4)	0.38	45
Determine cost of heating home with electricity (V-2)	0.34	46
V. Least Degree in Application (Mean score below $\bar{X}$-2s)		
Install remote control (I-11)	0.17	47
Calculate heat in BTU which must be removed to cool farm products (V-3)	0.13	48
Install air conditioner at home (V-5)	0.09	49

The ability to "Mount motor and adjust belt tension" is ranked 9.5 in application, but ranked 26th and 14th in importance and training. There may be some reasons for these teachers to teach these two abilities (Install heat lamp for pig . . ., and Mount motor and adjust tension), even though they did not rate these two abilities equally

high in importance and training. It may be that abilities like these two are: (1) very practical in application, (2) simple enough or can be accomplished with less time, less facilities or materials, and (3) related with other farm mechanics projects.

Abilities with very low ranks.--The following abilities were very seldom taught by the 47 teachers in their high schools: To "install air conditioner," "calculate heat in BTU which must be removed to cool farm products," "install remote control," "determine cost of heating home with electricity," "determine water requirements in gallons per hour for home and farmstead," "install time clock switch, thermostatic switch," and other abilities ranked very low in Table 20. Four of six abilities just mentioned belong to sub-area heating and cooling. This sub-area was rated as the lowest in importance and training. The abilities to "install remote control" and "install time clock switch, thermostatic switch" were also rated very low, as indicated in Tables 16 and 18.

These abilities with very low ranks are: (1) Not very often applied on the farms. For instance, farmers use motors more often than air conditioners; not many farmers have air conditioners in Michigan but motors are found on almost all farms. (2) Too specialized for high school students. For instance, the ability "to install time clock switch, thermostatic switch" appears to be too

big a job or too complicated for teaching high school students in a limited time, with limited facilities. To install time clock switch is usually a special job for electricians.

In selecting abilities for teacher preparation, those abilities that have been taught by the experienced teachers should be considered.

Degree of application of 49 abilities.--Based on the group mean of application and standard deviation, the distribution of abilities is divided into five intervals (or levels) as indicated in Table 21. Most abilities are in the second interval (44.9 per cent). More than 60 per cent of the abilities were taught by half of the 47 teachers in their high schools.

Comparison of the three ratings by the 47 teachers

Before making the comparison of the evaluations between the composite and the teachers, it seems necessary to compare the three kinds of ratings evaluated by the teachers. The purpose is to determine the degree of interrelationship of importance, training and application.

The research hypothesis is that there is direct interrelationship among the three aspects (importance, training and application) of the 49 abilities.

From this research hypothesis, three null hypotheses were developed: (1) Ratings of importance and training are

TABLE 21.--Distribution of mean scores of application of 49 abilities in rural electrification reported by 47 teachers of agriculture in Michigan, 1959.

Interval	Deviation from grand mean, $\bar{X}$	Frequency	Per cent	Degree of Application	Rank order
1.71-2.19	$\bar{X}$+s to $\bar{X}$+2s	7	14.29	First	1-7
1.23-1.71	$\bar{X}$ to $\bar{X}$+s	22	44.90	Second	8-29
0.75-1.23	$\bar{X}$-s to $\bar{X}$	11	22.45	Third	30-40
0.27-0.75	$\bar{X}$-2s to $\bar{X}$-s	6	12.24	Fourth	41-46
0.22-0.27	$\bar{X}$-3s to $\bar{X}$-2s	3	6.12	Least	47-49
Total		49	100.00		1-49

Data from Table 28.

independent of each other, there is no correlation between them. (2) Ratings of importance and application are independent of each other, and not related. (3) Ratings of training and application are independent of each other, there is no relation or correlation between them. The scatter diagram in Figs. 9, 10, and 11 and the estimating lines will be discussed before testing the hypothesis of correlation.

Scatter diagram of importance and training in Fig. 8.--The scatter diagram was first plotted in Fig. 8. Each of the numbers 1, 2, 3, . . . 49 represents an ability. For instance, "1" in Fig. 8 indicates ability I-1 in check-list

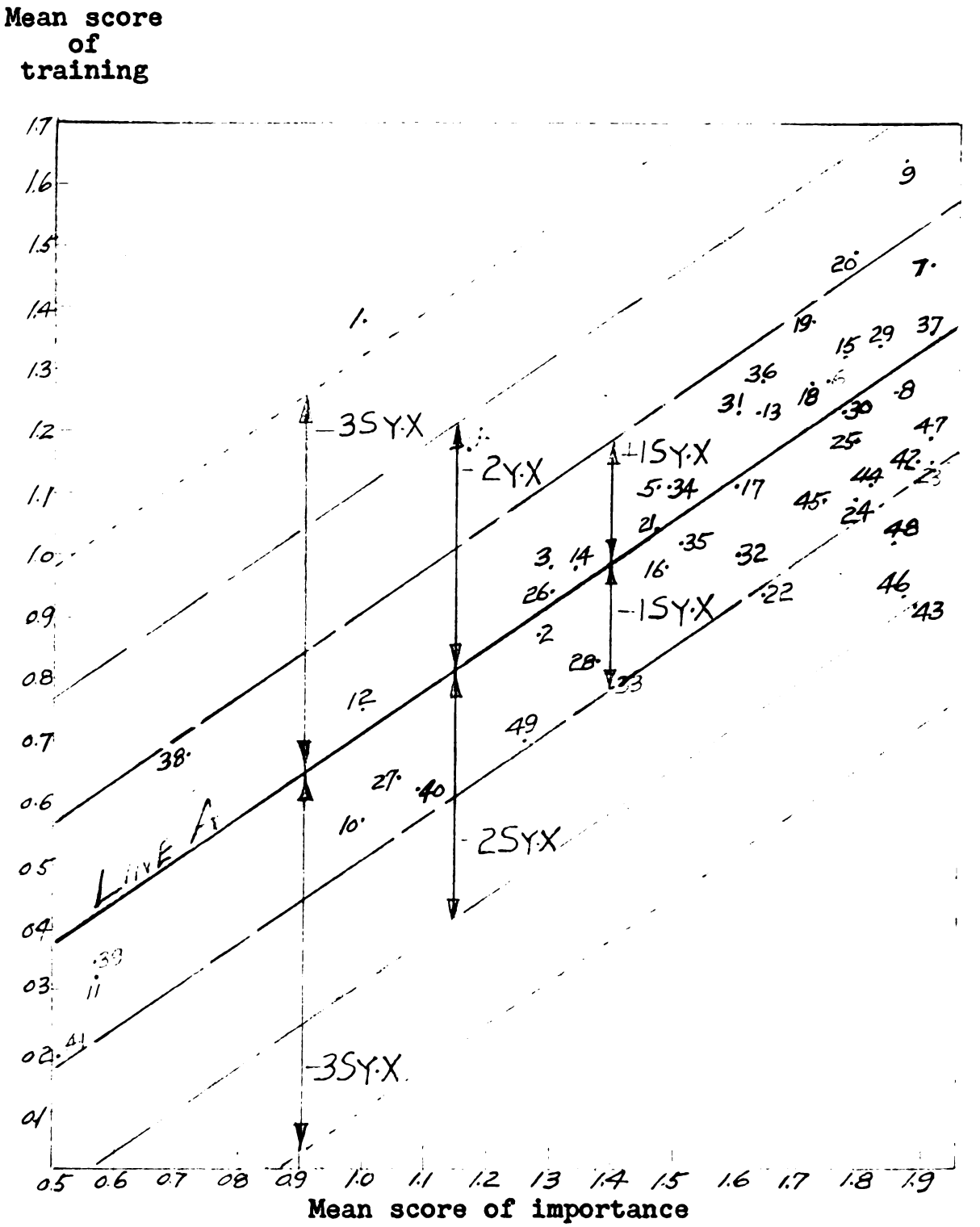


Fig. 8.--Estimating (or regression) equation and zones of ±1, ±2, and ±3 standard errors of estimate, for mean scores of importance and training of the 49 abilities reported by 47 teachers in Michigan.

Form B in Appendix B. (Compute monthly bills from meter and rate schedule). "13" represents ability II-1 (Plan wiring system for present and future loads). "28" represents "Replace brushes." All the numbers are in the parentheses after the 49 abilities in Appendix B.

Line A is the estimating line, which describes the nature of the relationship between importance and training. Line A reveals that there is positive correlation between importance and training. That is, the more important the ability, the more training the 47 teachers have received from it. This is a general estimation, because the 49 abilities are not all on the line A. The fact that so many abilities are either above or below Line A indicates variations or deviations from the estimate. Line A was plotted by estimating (or regression) equation.[7] ($Y=0.69x+0.03$)

To estimate the deviation of the mean scores of each of the 49 abilities from the estimating Line A, three zones (± 1, ± 2, and ± 3 standard errors of estimate, $S_{y.x}$) are used. The first zone covers the area between the two lines closest to Line A. (One line above and one below Line A, the narrow band, $\pm 1\ S_{y.x}$). Forty-one of the 49 abilities are within this narrow zone. That is, about 84 per cent of the abilities have deviations equal to or less

---

[7]Croxton and Cowden, op. cit., p. 457.

than one standard error of estimate.[8]

Three abilities (numbers 4, 9 and 20) above the first zone are deviated from Line A more than $1S_{y.x}$ but less than $2S_{y.x}$. Three abilities (numbers 22, 48 and 46), below the first zone, are also deviated from the estimating Line A more than $1S_{y.x}$ but less than $2S_{y.x}$. The variation of these six abilities is greater than that of the abilities in the first zone.

The ability number 43 is more than $2S_{y.x}$ from Line A, the variation greater than the six abilities. The greatest variation is ability number one. It is over $3S_{y.x}$.

Those abilities with very great variation need further investigation, because their ratings on training did not match with their importance.

(1) Ability number one, "Compute monthly bills from meter and rate schedule." The importance rank of this ability is 44th, the training rank is 4.5. The difference in rank is 39.5. The training is beyond its importance, since the training mean score is 0.38 points greater than the importance of this ability.

(2) Ability number 43, "Make electric fence controller safe." This ability was ranked 5.5 in importance but 37th in training, a difference of 31.5 ranks. The importance mean score is 0.97 higher than its training mean

---

[8] Ibid., p. 458.

score. The training in this ability does not seem sufficient to match its importance.

(3) Ability number four, "Compute energy consumption of various appliances (as: range, welder, . . .)." This ability was ranked 40th in importance, but 18th in training. The difference in rank is 22. The training in this ability outweighs its importance in terms of ranks.

Thus, abilities number one and four, which being very much above Line A, indicate that the training exceeds the importance significantly. While ability number 43, which is way below Line A, reveals that its importance outweighs its training.

Correlation between importance and training.--The coefficient of correlation[9] of the mean scores of importance and training of the 49 abilities as rated by the 47 teachers of agriculture is 0.803. This is significant at the one per cent level. Therefore, the null hypothesis that there is no relationship between the importance and training is rejected.

This level of significance approached the point where there is only one chance in one hundred of making an error of rejecting the null hypothesis. The alternate hypothesis is accepted, which stated that there is relationship

---

[9]Croxton and Cowden, op. cit., p. 469.

between training and importance of the 49 abilities. That is, the more important the ability, the more training the 47 teachers have received on it. More training was given to important abilities and less training to less important ones. In the sense that training is discriminating according to the importance of the abilities, the training appears to be adequate. However, reservations should be made that in a few abilities, as number one and number 43, the extent of training did not seem proportional to the importance.

Scatter Diagram of importance and application in Fig. 9.--The mean scores of importance and application of the 49 abilities as rated by the 47 teachers of agriculture were plotted in Fig. 9. The scatter diagram indicates some linear positive correlation. The relationship was estimated by the estimating Line B, which was plotted by the estimating (or regression) equation. (Y=1.06x-0.36)

Similar to Fig. 8, three zones are used to measure the degree of deviation of each of the 49 abilities from the Line B. Three abilities (number one, 43, and 44) are in the $\pm 3S_{y.x}$ zone. Their deviations from Line B are greater than all other abilities and are to be discussed as follows:

(1) Ability number one, "Compute monthly bills from meter and rate schedule." The importance rank of this ability is 44, (mean score 1.00), the application rank is 23 (mean score 1.36), the difference in rank is 21. This indicates that despite the fact that they rated it relatively

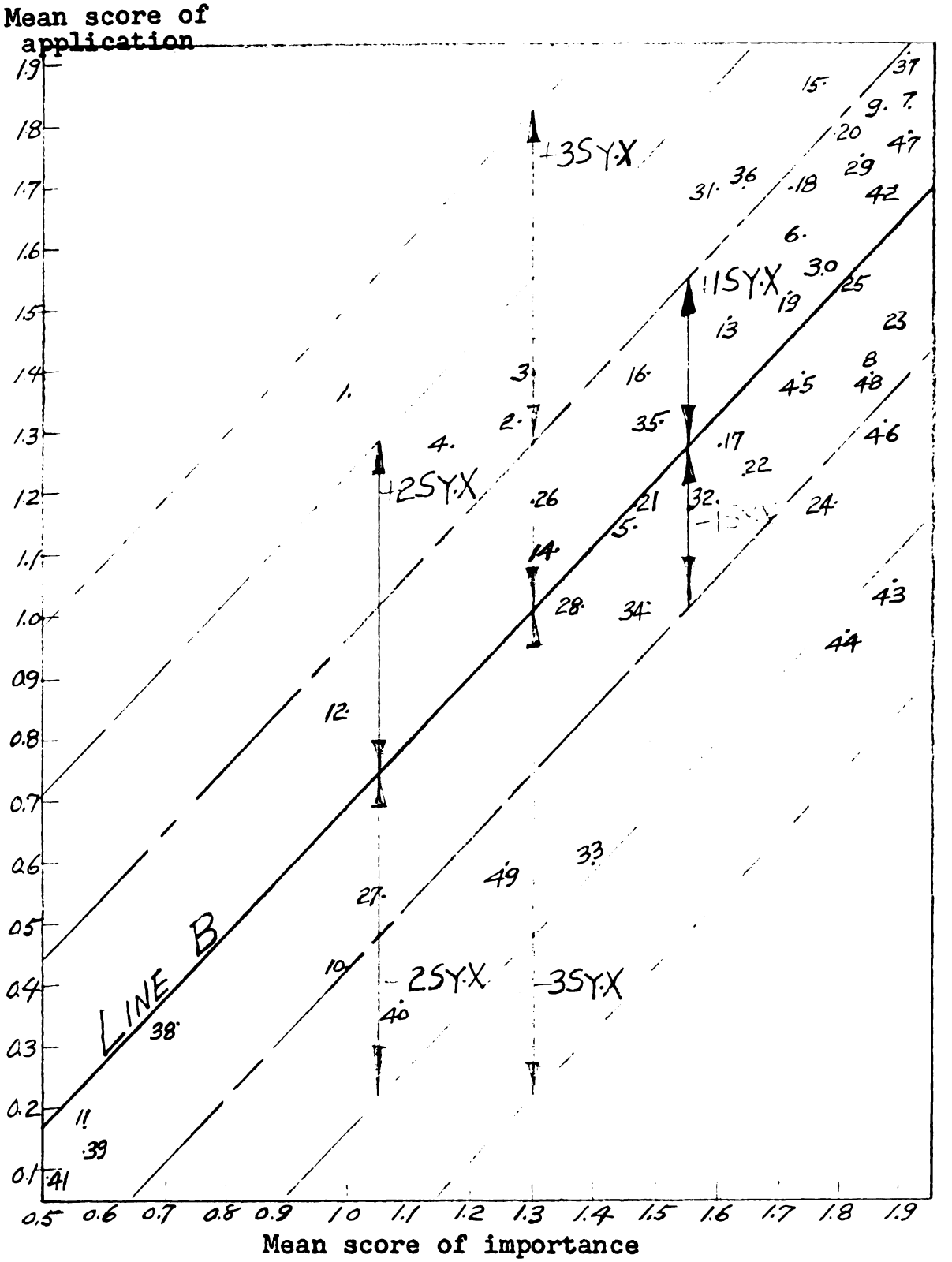


Fig. 9.--Estimating (or regression) equation and zones of ±1, ±2 and ±3 standard errors of estimate, for mean scores of importance and application of the 49 abilities reported by the 47 teachers of agriculture in Michigan.

unimportant, yet, they taught it quite often (difference in mean score is 0.36).

(2) Ability number 43, "Make electric fence controller safe." This ability is ranked 5.5 and 36th in importance and application respectively. The importance rank is 30.5 higher than its application rank. The mean score of importance is 0.83 over the application score. This reveals that this ability was not as frequently taught in the high school as the importance these teachers rated them would warrant. The training rank is 36th and the mean score is 0.92, which is below the fairly adequate level. It appears that the teachers did not teach this ability, which they thought important, due to insufficient training.

(3) Ability number 44, "Install fire-proof lighting fixture in hayloft properly." This ability was ranked 12th in importance and 39th in application, a difference of 27 ranks. The importance mean score is 0.83 higher than its application mean score. The importance of this ability appears to exceed its application in both rank and mean score.

The rank and mean score of training in this ability was lower than the importance rating, but training was rated higher than application both in rank and mean score, therefore, the low ratings in application may be due to other reasons as well as insufficient training.

Correlation between importance and application.--The correlation coefficient of the mean scores of importance

and application of the 49 abilities rated by the 47 teachers of agriculture is 0.835. This is significant at the one per cent level. Therefore the null hypothesis that there is no correlation between importance and application is rejected. The alternate hypothesis is accepted, which states that there is relationship between importance and application of the 49 abilities as rated by the 47 teachers. That is, the more important the ability, the more frequently the teachers would teach it in high schools. Conversely, the less important the ability, the less frequently they taught it. Although a few variations have been indicated by abilities number one, 43 and 44, as a whole, the frequency of the teachers of agriculture to teach the abilities in their high schools is directly related to their ratings of importance.

Scatter diagram of training and application in Fig. 10.--The relationship between the mean scores of training and application of the 49 abilities rated by the 47 teachers is shown in the scatter diagram in Fig. 10. There is a positive linear relation between training and application. The correlation was estimated by the estimating Line C, which was plotted by the estimating (or regression) equation. (Y=1.24x-0.07).

Three zones are used to measure the degree of deviation of abilities from the estimating Line C. None of the 49 abilities is in the $\pm 3S_{y.x}$ zone. That is, all

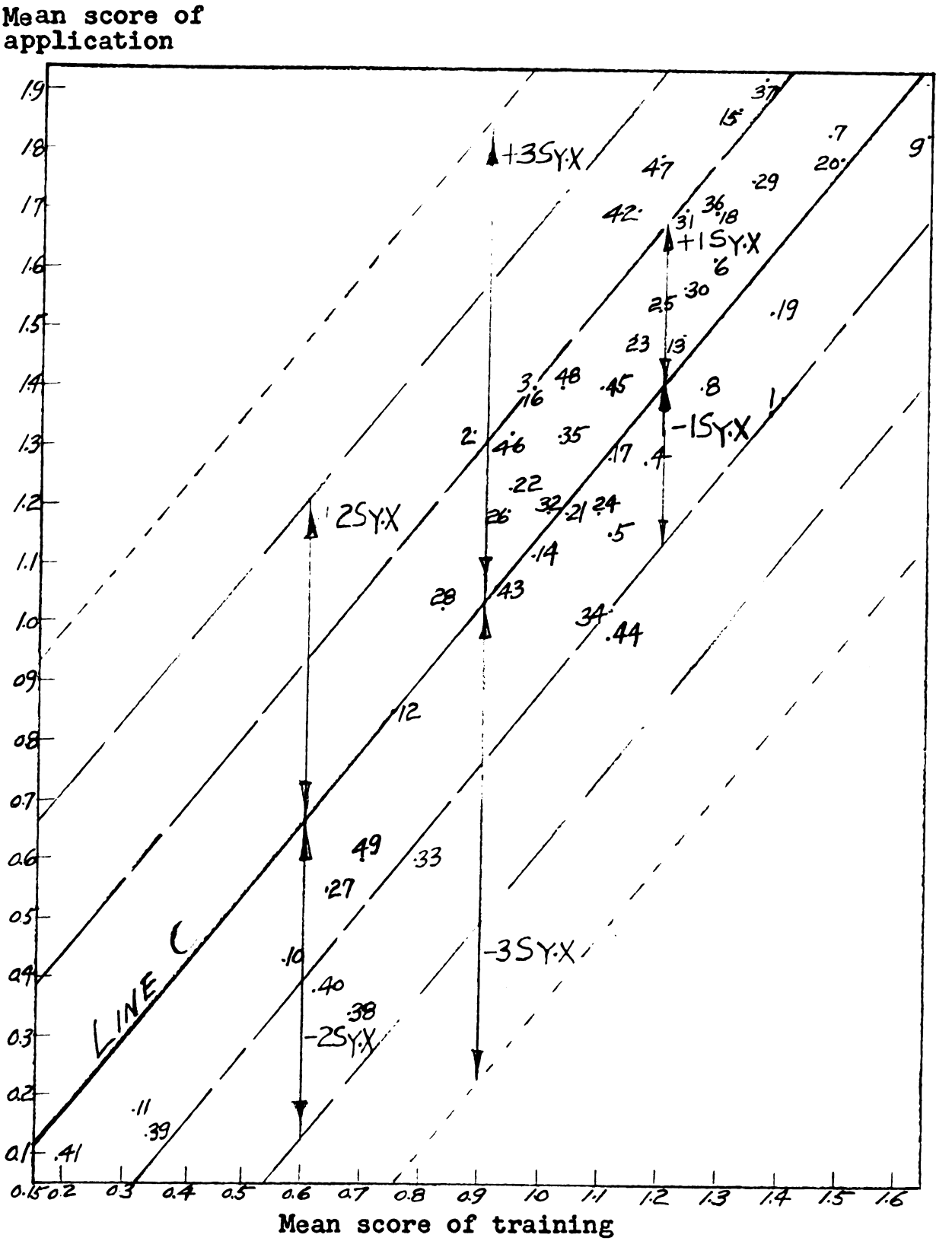


Fig. 10.--Estimating (or regression) equation and zones of ±1, ±2, and ±3 standard errors of estimate, for mean scores of training and application of the 49 abilities reported by the 47 teachers in Michigan.

abilities are less than two standard errors of estimate from the Line C. To compare the variation of Figs. 8, 9, and 10, this last one has the least.

Two abilities, numbers 38 and 47, have comparatively greater deviations from Line C than other abilities. The differences in ratings of the training and application of these two abilities are as follows:

(1) Ability number 38, "Determining cost of heating home with electricity." This ability was ranked 43th and 46th in training and application respectively. The rank difference is only three. But, the mean score of training is 0.68, which is double that of the mean score on application, 0.34. Therefore, the frequency of teaching this ability was not proportional to the training. Its rank of importance is 46th, which is very low. It may be this is one of the reasons that this ability was taught less frequently.

(2) Ability number 47, "Recognize hazards of substandard wiring." This ability was ranked 16.5 and 5.5 in training and application respectively, the application exceeds training by 11 ranks. Application outweighed training in this ability in terms of ranks. This ability was ranked 2.5 in importance, therefore, it is very important. Compared with its importance and the frequency of teaching it in high school, the training of this ability did not seem sufficient to match its application and importance.

Correlation between training and application.--The correlation coefficient of the mean scores of training and application of the 49 abilities rated by the 47 teachers of agriculture is 0.832. This is significant at one per cent level, because 0.832 is greater than 0.372, the value needed to be significant at one per cent level. Therefore, the null hypothesis of no correlation between training and application is rejected. The alternate hypothesis is accepted, which stated that there is relationship between training and application of the 49 abilities as rated by the 47 teachers. That is, the more training the teachers received in the ability, the more frequently they taught it in their high schools. Conversely, the less training they received in an ability, the less frequently they taught it in high schools. The frequency with which the teachers of agriculture would apply what they learned from the Michigan State University in the field of rural electrification is proportional to the amount of training they received.

Interrelationship of importance, training and application.--To sum up, there is direct interrelationship of importance, training and application of the abilities rated by the 47 teachers of agriculture. The three correlation coefficients are: (1) importance and training, 0.803; (2) importance and application, 0.835; and (3) training and application, 0.832. The second coefficient is greater than the other two, but the differences among these coefficients

are not significant.

The implication of the direct interrelationship of importance, training and application is: by training the teachers in those abilities which they need (that is, those abilities the teachers rated much lower than the composite) would make them rate those abilities more important and more teachers would teach them in the high schools.

The problem to be discussed in the following section is how to evaluate the differences in ratings between the composite and the teachers. Based on the composite rating, the abilities in which the teachers need more training will be the course content for their in-service training.

Comparison of the Evaluations Between the Composite and the 47 Teachers of Agriculture

The basis for determining the course content for the in-service training for the teachers is to compare the ratings of the composite and the teachers.

To ascertain the degree of similarity and/or variability between the evaluations of the teachers on importance, training and application and the composite, the following comparisons are made: (1) comparison of the means, (2) comparison of the sub-areas, (3) comparison of the variations and the distribution of abilities, and (4) comparison of the rank order, or the rank correlations.

Based on the above comparisons and the comparison of

each of the 49 abilities with respect to the differences in mean scores, ranks, degree of importance, level of training and frequency of application, the abilities needed in the course content for in-service training are determined.

Comparison of the means.--The means of the composite, the teachers' ratings on importance, training, and application are 1.43, 1.50, 1.03 and 1.23 respectively, as indicated in Table 22. To test whether the differences among the four means are significant or not, the t-test was used. As revealed in Table 22, except the difference in means of importance as rated by the composite and the teachers, (1.28), which is not significant at five per cent level, all the other five mean differences are significant. Four of them are significant at the one per cent level and the mean difference between the training and application as rated by the 47 teachers is significant at the five per cent level.

Since the importance ratings by the composite and the teachers are significantly higher than the ratings on training and application, the need for more training and application is suggested.

Comparison of the four ratings on the six sub-areas.--The comparison of the mean scores of sub-areas by the 47 teachers and the composite is in Table 23. The highest mean score in Table 23 is 1.78, which was rated by 47 teachers on the importance of the sub-area safety. The lowest mean score in the same table is 0.57, which was rated by the 47

TABLE 22.--Comparison of the means of the composite and the 47 teachers in Michigan

	Mean scores	Level of significance of the mean differences of the four ratings: Ratings by the 47 teachers on Importance	Training	Application
Composite	1.43	1.28 n.s.	7.5**	3.47**
Importance (teachers)	1.50	--	6.15**	3.61**
Training	1.03	--	--	2.67*
Application	1.23	--	--	--

**Means highly significant (one per cent level, $p < .01$).

*Means significant (five per cent level, $.01 < p < .05$).

n.s. Means not significant.

teachers indicating how frequently they have taught the abilities in the sub-area heating and cooling.

Comparison of the ratings by profiles.--Figure 11 compares the four profiles of ratings based on Table 23. The profile of training is the lowest and the profile of importance rated by the 47 teachers is the highest. The profile of importance rated by the composite is the next highest of the four. The profile of application is between the training profile and the composite profile. (Only the heating and cooling sub-area is lower). This indicates that training and application do not match with the importance

TABLE 23.--Comparison of the ratings on the six sub-areas by 47 teachers and the composite.

Sub-area	Composite	The 47 teachers (mean scores) Importance	Training	Application
Basic abilities	1.33	1.35	1.07-	1.22
Wiring	1.51	1.61	1.17	1.46
Motors	1.49	1.60	1.07+	1.33
Lighting	1.45	1.53	1.04	1.17
Heating and cooling	0.96	0.96	0.64	0.57
Safety	1.70	1.78	1.01	1.28
Means of 49 abilities	1.43	1.50	1.03	1.23

in each of the six sub-areas. It seems necessary to have more training and application, as suggested previously.

Heating and cooling is the lowest sub-area of all four profiles. That is, the ratings on training, on application, and on importance by the 47 teachers and the composite are all at the lowest level. In training and application, the sub-area wiring has the highest mean scores, but both the composite and the 47 teachers rated safety as the most important.

The gaps among the four profiles at the sub-area safety appear to be greater than at other sub-areas. It

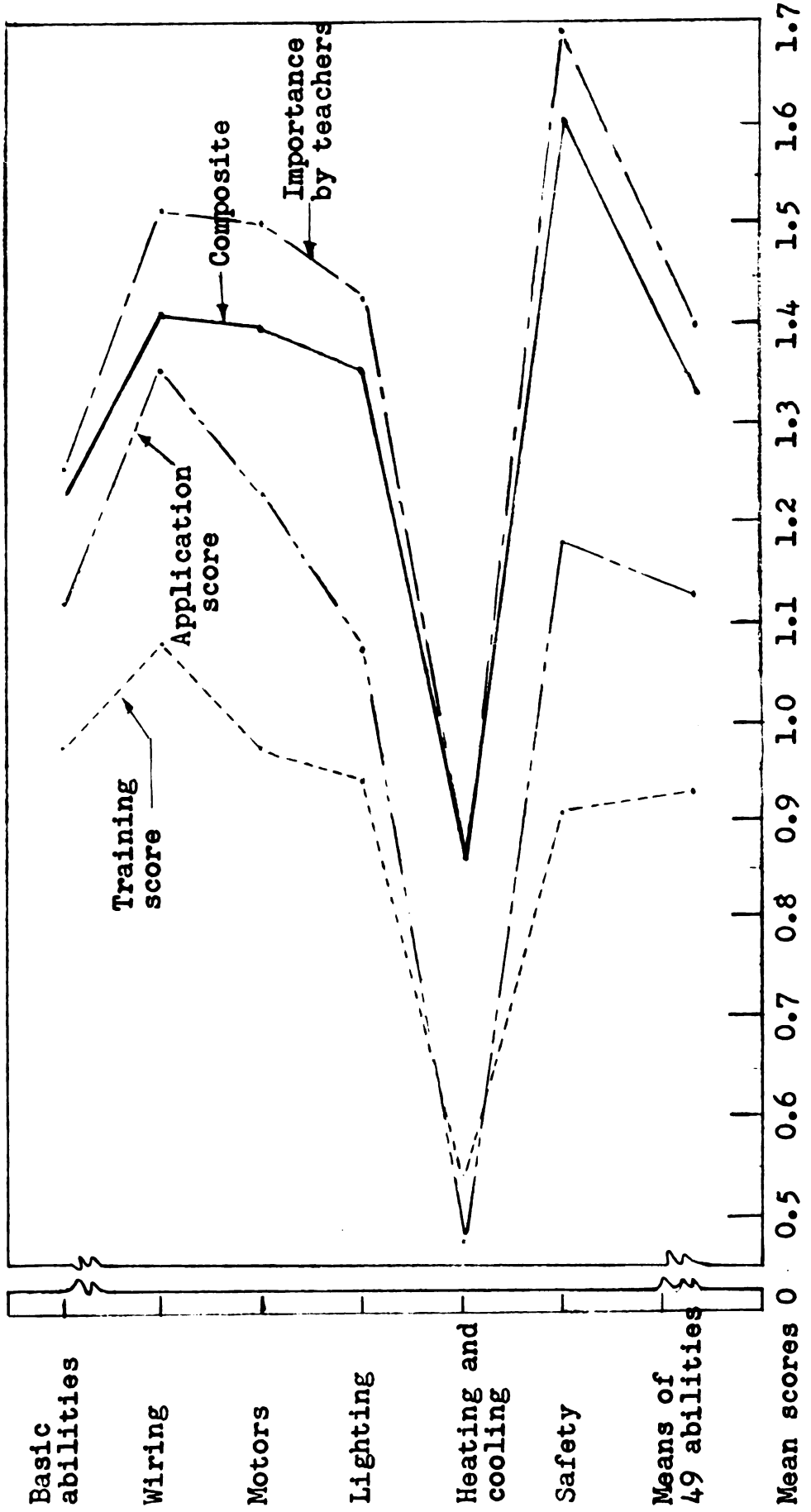


Fig. 11.--Comparison of the profiles of mean scores of importance, training, and application as reported by 47 teachers and the mean scores of importance as reported by the composite. Data from Table 23.

reveals that in the sub-area safety, training and application lags behind the importance to a much greater degree than for other sub-areas. More training seems to be needed in the sub-area safety.

Comparison of the variations and the distribution of abilities.--Table 24 indicates the variations and the distribution of abilities in various levels. The application scores have a range of 1.83 and standard deviation 0.48. This reveals that there is more variation within the ratings in application. For instance, the ability "Install heat lamps for pig or chicken brooding" was rated as high as 1.92, but "Install air conditioner" was rated as low as 0.09. In other words, only two teachers did not teach the former ability, and only two teachers taught the latter ability. The discriminating between the abilities in application is great.

The importance ratings of the 49 abilities as reported by the composite and the teachers are 51 and 57.2 per cent respectively above 1.50, as shown in Table 24, but in the training, only two per cent. Therefore, most of the abilities are rated very high on importance but very few are high in training. For those mean scores below 1.00, the percentages of the 49 abilities on importance as rated by the composite and the teachers are 12.2 and 8.1 respectively, but on training, 38.8 per cent. This also indicates that more training is needed by these teachers.

TABLE 24.--Comparison of the ratings of composite and the 47 teachers of agriculture on the rank order of 49 abilities.

	Composite (seven groups)	47 teachers of agriculture		
		Importance	Training	Application
Highest mean score	1.88	1.91	1.64	1.92
Lowest mean score	0.48	0.51	0.19	0.09
Range	1.40	1.40	1.45	1.83
Standard deviation	0.33	0.39-	0.33	0.48
Per cent of abilities with mean scores over 1.50	51.0	57.2	2.0	30.6
Per cent of abilities with mean scores from 1.00 to 1.50	36.8	34.7	59.2	47.0
Per cent of abilities with mean scores below 1.00	12.2	8.1	38.8	22.4

Forty-seven per cent of the 49 abilities have application mean scores from 1.00 to 1.50, only 30.1 per cent of them above 1.50. This indicates that the teachers did not teach many abilities that the composite rated as important.

From the above comparisons (means, sub-areas and

distributions of abilities) it is evident that the ratings in training and application are lower than importance. Apparently, there is a need for more training.

In the comparisons of the three ratings by the teachers, (p. 130) it was found that the interrelationship of importance, training and application is significant. (The correlation coefficients are 0.80, 0.84 and 0.83, see page 142). It is intended to investigate the correlation between the composite and the three kinds of ratings evaluated by the teachers in the following section.

Comparison of the rank order or rank correlations.-- The research hypothesis is that there is direct correlation between the composite rating and each of the three ratings by the teachers. From this research hypothesis, three null hypotheses were developed: (1) Importance ratings by the composite and the teachers are independent of each other, (2) The composite ranks and the training ranks of the 49 abilities are independent of each other, and (3) The composite ranks and the application ranks of the 49 abilities are independent of each other. There is no correlation between them.

Spearman rank correlation was used to test the null hypotheses of independence. Table 25 indicates that all the rank correlation coefficients are significant at the one per cent level, so the null hypotheses of independence are all rejected. That is, there is direct relationship

TABLE 25.--Comparison of the agreement between the composite and the teachers on the rank order of the 49 abilities indicated by the rank correlation coefficients.

	Rated by the 47 teachers on		
	Importance	Training	Application
Composite	0.90**	0.61**	0.58**

**Highly significant, at the one per cent level $p < 0.01$.

between the composite and the teachers on the rank order of the 49 abilities. For instance, if the composite rank is very high, as a general rule, the ranks of importance, training, and application as rated by the teachers are also high. Conversely, if the composite ranks an ability low, the other ranks would be also low.

This relation is used as a reference to determine whether an ability should be in the course content for the in-service training. For example, the ability "Prevent electric shock," was ranked fifth by the composite, but teachers ranked it 18.5 and 25.5 in training and application respectively. The differences in ranks are 13.5 and 17. The fact that the composite ratings out-ranked the teachers' ratings in training and application from 13.5 to 17 ranks reveals the need for more training and application (Table 26).

TABLE 26.--Section table showing the data used in selecting abilities for the preparation of teachers of agriculture in Michigan.

Ability		Composite (C)	Importance (I)	Training (T)	Application (A)	Mean score and rank differences C-T*	I-T**	C-A***	Need of training
I-1	Mean score	1.06	1.00	1.38	1.36	-0.32	-0.38	-0.30	No
	Rank	43	44	4.5	23	-38.5	-39.5	-20	
I-2	Mean score	1.52	1.28	0.87	1.32	0.65	0.41	0.20	Need
	Rank	24	38	38	25	14	0	1	
I-4	Mean score	1.21	1.17	1.17	1.28	0.04	0	0.07	option-
	Rank	39	40	18	27.5	-21	-19	-11.5	al
I-11	Mean score	0.63	0.57	0.32	0.17	0.31	0.25	0.46	No
	Rank	48	47.5	48	47	0	0.5	1	
VI-4	Mean score	1.78	1.74	1.09	1.40	0.69	0.65	0.38	Much
	Rank	5	18.5	25.5	20	13.5	7	17	need

*Composite - training
**Importance (by teachers) - training
***Composite - application

Abilities needed by the teachers for in-service training

To determine the abilities that will be needed for teacher training, each of the four ratings of the 49 abilities was compared with respect to the differences in mean scores, ranks, degree of importance, level of training, frequency of application and other considerations. Table 26 shows the method of determining the abilities in the course content for in-service training. For instance, ability I-1, "Compute monthly bills from meter and rate schedule," needs no further training, since its rank is 38.5 higher than the composite, and its mean scores in training and application are greater than the mean scores of importance rated by the composite (0.32 and 0.30 respectively). The minus signs used in Table 26 indicate that the composite rating is smaller than the ratings of training and application.

Ability I-2, "Select electrical applicances for convenience, economy, and safety," the composite rated 0.65, and 0.20 points higher than the mean scores of training and application respectively. The composite outranked training by 14 ranks. Therefore, this ability is needed in the course for in-service training.

Ability I-4, "Compare energy consumption of various applicances," is optional, since the mean score differences are small, (0.04, 0 and 0.07) and the ranks in training and application are higher than the ranks of importance, as

rated by the composite and the teachers.

Ability I-11, "Install remote control" needs no further training, because the composite rated it not important (mean score 0.63).

Ability VI-4, "Prevent electric shock," is very much needed in the course content for in-service training, since the mean differences are great (the differences between the composite and training, teachers' rating of importance and training, and composite and application are 0.69, 0.65, and 0.38 respectively), and the ranks of importance by the composite and the teachers are 13.5, 7, and 17 higher than the ranks of training and application.

Each of the 49 abilities was analyzed in a similar way to determine the need of training or preference in the course content for in-service training. These 49 abilities are divided into four groups according to the degree of needs: (a) no need for further training, (b) optional, (c) needed abilities and (d) much needed abilities.

Abilities needing no further training.--Teachers do not need in-service training in the following 11 abilities:

Compute monthly bills from meter and rate schedule. (I-1)

The above ability is the only one in which the training mean score is higher than the importance mean score. There is no need for in-service training in this ability. Since most of the teachers and the composite

did not rate it as important as the training, it may not need much emphasis in training the prospective teachers.

The following six abilities were rated by the composite with mean score less than 0.90. They are not important. Therefore, there is no need to include them in the course content.

Install time clock switch, thermostatic switch. (I-10)

Install remote control. (I-11)

Charge storage battery. (I-12)

Determine cost of heating home with electricity. (V-2)

Calculate heat in BTU which must be removed to cool products. (V-3)

Install air conditioner. (V-5)

The application mean scores of the following four abilities are greater than the composite mean scores, and their training mean scores are about equal to the composite scores. There is no need for further training of the teachers in the following four abilities.

Repair damaged cords and make proper splices. (I-9)

Install 3-way and 4-way switches. (II-7)

Wire a circuit for general purpose lights and outlets. (II-8)

Install light fixture. (IV-5)

Optional abilities.--The following nine abilities may be needed by some teachers but not by most of them. Therefore, these nine abilities may be included in the course

content as electives or optional.

Select wiring materials. (II-3)

Locate outlets and switches. (II-6)

Interpret motor nameplate information. (III-7)

Mount motor and adjust belt tension. (III-9)

Install heat lamps for pig or chicken brooding. (V-1)

The application mean scores are greater than the composite mean scores in the above five abilities, and the training scores are from 0.22 to 0.36 less than the composite. Since the composite rated the above five abilities lower than the teachers in application scores, and the training scores are not much lower than the composite, therefore, only a few teachers need further training in them.

For a similar reason the following four abilities are optional, because the composite did not rate much higher than the application. (Only 0.01 to 0.08 points difference).

Compute energy consumption of various appliances. (I-4)

Comply with electrical code and select Underwriters' Laboratory approved materials. (I-6)

Clean and lubricate motors. (III-3)

Change direction of rotation of motors. (III-4)

Abilities needed by the teachers.--The teachers need further training in 29 of the 49 abilities. Some training should be given in nine of these abilities since the composite mean scores are either 0.10 point greater than the application

mean scores or 0.40 points greater than the training mean scores. The nine abilities are as follows:

Wire a circuit for special outlets. (II-9)

Replace brushes. (III-6)

Compare cost of electricity with other sources of power. (I-3)

Determine types and sizes of fuses for protection. (I-7)

Select service entrance switch. (II-4)

Change voltage of dual voltage motor. (III-5)

Select pulleys and belts for machine of desired speeds. (III-8)

Select lighting equipment for home and yards. (IV-4)

Determine water requirements in gallons per hour for home and farmstead. (V-4)

More training should be given in the following 12 abilities, since the mean differences between the composite and the teachers are greater. The composite is either 0.20 or 0.50 points over the application and training respectively in the first seven of the following 12 abilities:

Recognize sources of reliable information on rural electrification. (I-5)

Plan wiring system for present and future loads. (II-1)

Locate load center and distribution center. (II-2)

Determine number of branch circuits in new buildings. (II-5)

Determine voltage drop and its effect on lighting. (IV-3)

Ground equipment and wiring system safely. (VI-1)

Recognize hazards of substandard wiring. (VI-6)

Select electrical appliances for convenience, economy and safety. (I-2)

Locate hazards such as short or open circuits, . . . (I-8)

Determine light requirements for various areas and jobs. (IV-2)

Protect buildings from hazards of lightning. (VI-7)

Use ultraviolet lamp and other special lamps safely. (VI-8)

The composite is both 0.20 and 0.50 points greater than the application and training scores respectively in the last four of the above 12 abilities. The mean scores of the abilities which need more training should be greater than 1.25, as rated by the composite, since more training should be given to those abilities which are comparatively more important.

Abilities in which the teachers need much more training.--All of the following eight abilities should be given much more emphasis, since the mean score differences between the composite and the application and the training in these abilities are all much greater than the differences mentioned above. All these mean scores are over 1.50, and the composite score is 0.30 and 0.60 points greater than the application and the training scores respectively.

Use judgment to revise present wiring system. (II-10)

Select proper types and sizes of motors. (III-1)

Select proper overload protection. (III-2)

Recognize effects of poor lighting in quantity and quality. (IV-1)

Make electric fence controller safe. (VI-2)

Install fire-proof lighting fixture in hayloft properly. (VI-3)

Prevent electric shock. (VI-4)

Use fire fighting equipment for electric fires. (VI-5)

Four of the above eight abilities belong to the sub-area safety. It substantiates the finding in Fig. 11, in which the gaps among the profiles at the sub-area safety was greater. Apparently much more training is needed and preference should be given to the eight abilities over the other abilities in the course content for in-service training.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of the present study is to find a basis for course content in rural electrification for the pre-service and in-service training of the Michigan teachers of agriculture.

Agricultural engineers, leaders in teacher education, prospective teachers and young farmers collaborated in preparing the check-list with 49 abilities divided into six sub-areas.

The check-list was rated by seven groups: 19 leaders in teacher education, 47 teachers of vocational agriculture, 25 prospective teachers of agriculture, 15 agricultural engineers, 28 rural servicemen, 32 farmer members of advisory councils and 50 young farmers.

The 47 teachers of agriculture rated the adequacy of training and frequency of teaching of the 49 abilities in their high schools. The teachers' ratings were compared and evaluated with the ratings by the seven groups. The course content for in-service training was based on the comparisons and evaluations.

The balance of this chapter presents a summary of the findings of the present study, with conclusions, and recommendations developed from it.

Summary of Findings

The evaluation of importance by 216 respondents.--The rank order of the 49 abilities rated by 216 respondents is listed in Table 7. These respondents rated all the abilities between the "fairly important" and the "very important" level. They rated safety very important.

Six abilities belonging to the sub-areas of basic abilities and heating and cooling are below the "fairly important" level. The 49 abilities were divided into five degrees of importance.

The rank order of the six sub-areas is: safety, wiring, motors, lighting, basic abilities and heating and cooling. There was unanimous opinion in rating the sub-area heating and cooling as least important. The sub-area of safety was rated by all but agricultural engineers as the most important. All except the young farmers' group ranked the sub-area safety the fifth in importance. The rank of the sub-area motors showed the greatest variation. There was partial agreement among the seven groups on the rank order of importance of the six sub-areas.

The distribution of abilities of each of the six sub-areas in the five degrees of importance is summarized in Table 13. All the abilities in the sub-areas of wiring, motors, lighting and safety are in the first three degrees of importance, and they are all above the "fairly important"

level.

The 12 abilities in the sub-area of basic abilities are distributed in the five degrees of importance. Four of the abilities are in the fourth and least degrees of importance, and they are either "fairly important" or "relatively unimportant."

In the sub-area of heating and cooling, four of the five abilities are in the fourth and least degrees of importance, only one ability is in the second degree of importance. Although this sub-area was rated lower than any of the other sub-areas, one ability in this sub-area is rated higher than one or more abilities in the other five sub-areas. (Table 13)

The four groups related to the profession of teaching, (leaders in teacher education, teachers of agriculture, prospective teachers, and agricultural engineers), rated the importance of the 49 abilities higher than the composite. The other three groups not related to the teaching profession rated lower than the composite. However, the mean differences of the following groups are the only ones which are significant at the five per cent level: (a) Young farmers and the teachers of agriculture, (b) young farmers and leaders in teacher education and (c) farmer members of advisory councils and the leaders in teacher education.

The evaluations by the 47 teachers.--The rank order of importance, training and application as rated by the 47

teachers are listed in Tables 16, 18 and 20 respectively.

The group mean score of importance is 1.50, which is between "fairly important" and "very important." More than 57 per cent of mean scores of importance are over 1.50. Only four abilities have mean scores below 1.00. This indicates that the teachers rated the abilities a little more important than the composite.

The teachers ranked abilities related to safety very high. They ranked "Prevent electric shock," 13.5 points lower than the composite. They outranked the composite by 19 in the ability "Install heat lamps for pig or chicken brooding."

Those abilities ranked as the lowest by the composite were also ranked as the lowest by the teachers.

The group mean score of training is 1.03, which is near the "fairly important" level. Only two per cent of the 49 abilities with mean scores of training is over 1.50, and 38.8 per cent of them have mean scores less than 1.00. Thus, the training was not rated as high as the importance of the various abilities.

Some of the abilities with very high ranks in importance, as rated by the teachers and the composite, were ranked also very high in training. However, five abilities in safety ranked very high in importance but quite low in training. There is more similarity in the rank order of importance and training at the very low ranking level than

at the very high ranking level.

The group mean score of application is 1.23, which is lower than the importance rating but greater than the training rating. Most of the 49 abilities were taught by the 47 teachers. About seventy-eight per cent of the 49 abilities have mean scores of application above 1.00. Nearly forty per cent of the 49 abilities have mean scores of application above 1.50.

Abilities with very high ranks in application were also ranked very high either in importance or in training or both, although a few abilities like "Install heat lamps for pig or chicken brooding," and "Mount motor and adjust belt tension," were not ranked very high in training.

Interrelationship of importance, training and application of the 49 abilities rated by the teachers.--The three correlation coefficients indicate that the interrelationship is highly significant (at the one per cent level).

The correlation coefficient between importance and training is 0.80. It is highly significant. However, the ability "Compute monthly bills from meter and rate schedule," was rated to have more training involved than its importance would indicate, as revealed in Fig. 8. On the other hand, the ability "Make electric fence controller safe," was rated quite important by the teachers, and they indicated more training is needed in this ability (number 43 in Fig. 8).

The above two abilities have the greatest variations. As a whole, the relationship between the importance and the training is highly significant.

The correlation coefficient between importance and application is 0.84. It is highly significant. However, there are variations. Again, the ability "Compute monthly bills from meter and rate schedule" was taught in the high schools quite frequently, but the teachers did not rate it as important. The other two abilities "Make electric fence controller safe," and "Install fire-proof lighting fixture in hayloft properly," were rated important, but were not taught in the high schools frequently.

The correlation coefficient between training and application is 0.83. It is highly significant. Despite some minor variations, the amount of training was related to or proportional to the frequency of the abilities being applied in the local schools.

Comparisons of the composite evaluations and the evaluations by the teachers.--The composite mean and the group means of importance, training and application are 1.43, 1.50, 1.03 and 1.23 respectively. The importance ratings by the composite and the teachers were significantly greater than the ratings of training and application. A comparison of the four profiles in Fig. 11 revealed that training was rated as the lowest and the importance rating by the teachers was the highest. The gaps among the profiles

at the sub-area safety were greater than for other sub-areas. Heating and cooling was rated as the lowest sub-area of the four ratings.

Most of the abilities were rated high in importance but low in terms of training. The application ratings were lower than the rating of importance but higher than the rating of training, as indicated in Table 24.

The rank correlations among the four ratings were all highly significant, as revealed in Table 25.

Abilities needed by the teachers for in-service training.--Based on the above general comparisons and the comparisons of the four ratings of each of the 49 abilities, the degree of further training needed by the teachers was ascertained.

Conclusions

The conclusions concerning research hypotheses and the general conclusions will be presented as follows.

The research hypotheses

The hypotheses listed in Chapter I were tested for validity through the use of various statistical procedures mentioned in Chapter III. Each of the hypotheses is reported in the following.

Hypothesis one.--The degree of importance of the 49 abilities rated by the 216 respondents varies greatly.

This hypothesis is considered to be valid, since the null hypothesis of no significant difference among the mean scores was rejected.

Hypothesis two.--There is agreement among the seven groups in the rank order of importance of the six sub-areas. This hypothesis was considered to be valid if all the correlations among the groups were significant.

This hypothesis is not considered to be valid, since the correlation coefficients among some of the groups were not significant. However, there is partial agreement among the groups, because many coefficients were significant.

Hypothesis three.--The disagreement among the seven groups in their rating of the importance of the total of 49 abilities is not significant.

Since the mean differences among the three paired groups (a) young farmers and teachers of agriculture, (b) young farmers and leaders in teacher education and (c) farmer members of advisory councils and leaders in teacher education were significant, the validity of this hypothesis is not established.

The mean differences among the other paired groups were not significant, therefore, partial disagreement among the groups mentioned above is significant.

Hypothesis four.--There is interrelationship of importance, training and application as rated by the teachers.

Since the three correlation coefficients were all highly significant, the validity of this hypothesis is established.

Hypothesis five.--The differences among the four means (1.43, 1.50, 1.03 and 1.23 in Table 22) rated by the composite and the teachers are not significant.

Since only the mean difference between the composite and the teachers' rating in importance is not significant and all the other five mean differences (Table 22) are significant, the validity of hypothesis five is not established.

Hypothesis six.--There is relationship on the rank order of the 49 abilities as rated by the composite and the three ratings by the teachers.

Since the three rank correlation coefficients are all highly significant, as shown in Table 25, the null hypothesis of independence was rejected. Therefore, the validity of hypothesis six is established.

The general conclusions

The findings of the present study, as based on the composite evaluations of the seven groups, which were closely associated with rural electrification education in Michigan, justify the following conclusions:

1. The total abilities as a whole were considered important by the composite. Only six abilities are below the fairly important level, all other abilities are important.

2. The degree of importance of the 49 abilities varies greatly. The highest mean score is almost four times the lowest mean score. Some of the abilities are significantly more important than other abilities; this provides the basis on which to choose the abilities to include in the course content.

3. Most abilities in the sub-area "safety" or "related to safety" were rated of the greatest importance, while most of the abilities in the sub-area of heating and cooling were rated as the lowest.

4. The rank order of the six sub-areas were partially agreed upon by the seven groups.

5. The abilities within each of the six sub-areas are in different degrees of importance, as shown in Table 13. Abilities in the sub-areas of wiring, motors, lighting and safety are all important enough to be included in the course content for in-service training. The rating of the abilities in the sub-areas of basic abilities and heating and cooling are very heterogenous; some of these abilities need not be included in the course.

6. Difference between abilities is sometimes more discriminating than between the sub-areas.

7. The people in the teaching profession rated the 49 abilities higher than the other three groups. The standard of the leaders in teacher education and the teachers of agriculture was higher than the two farmers' groups.

8. Except for a few abilities related to safety, training in most of the abilities was given in proportion to importance. Conversely, the more training the teachers had received on an ability, the more important the teachers tended to rate it.

Similarly, the frequency of teaching each of the 49 abilities was directly related to the ratings of importance and the adequacy of training in that ability.

9. The teachers rated the total of 49 abilities slightly higher than did the composite, but the difference is not significant (Fig. 11).

10. The training was rated significantly lower than the importance and application, and the application was rated lower than importance. Therefore the training was not adequate and many teachers need more training in many abilities.

11. The rank relationship between the composite and the teachers' ratings is significant.

Recommendations

The recommendations are made in view of the findings of the present study, the literature reviewed and the discussions with some leaders in rural electrification education in Michigan. They are divided into educational and research sections on the basis of the application possibilities.

Implication to teacher education

The course content for prospective teachers.--In determining the course content for the training of prospective teachers of agriculture in Michigan, following are the recommendations:

1. All but the following four abilities should be included in the course content:

Install air conditioner. (V-5)

Install remote control. (I-11)

Calculate heat in BTU which must be removed to cool farm products. (V-3)

Install time clock switch, thermostatic switch. (I-10)

The mean scores of the above four abilities were rated below 1.00 by the composite. They are not important.

2. The following three abilities may be included in the course as optional, because they are in the "fairly important" level:

Determine water requirements in gallons per hour for home and farmstead. (V-4)

Compute monthly bills from meter and rate schedule. (I-1)

Determine cost of heating home with electricity. (V-2)

Charge storage battery. (I-12)

3. More emphasis should be given to important abilities. Comparing with the composite, the teachers were not competent in many abilities. It seems desirable to

concentrate the effort to the training of teachers in the abilities in the first three degrees of importance. It was suggested that the eight abilities mentioned above be omitted or listed as optional items.

4. The weight of each of the abilities within the same sub-area may not be the same. For instance, in the sub-area basic abilities, the two abilities I-7, and I-8, are in the first degree of importance, as shown in Table 7; more detailed instructions, more illustrations and more enriched materials should be given to these two abilities and less space and instructional materials should be given to the ability I-4, which is in the third degree of importance (Table 7, rank 39th).

5. Tables 7 and 13 should be used to ascertain the importance of the abilities in the sub-areas. Preference should be given to the six abilities in the first degree of importance, then to the 24 abilities in the second degree of importance and so on.

The course content for in-service training.--Based on the composite rating of importance, the abilities that the teachers rated very low in training and application reflect the needs for further training. Those abilities in which the teachers need more training should be included in the course content. Following are the recommendations:

1. In terms of needs, it was suggested in Chapter IV that: (a) the teachers need no further training in 11

abilities and these abilities need not be included in the course content, (b) nine abilities should be categorized as optional items, (c) the teachers need further training in 29 abilities, they need some training in nine of the 29 abilities, they need more training in 12 of the 29 and they need intensive training in the other eight abilities.

2. The amount of instructional materials should be in proportion to the needs of training. Preference should be given to those abilities needing much more training.

3. The abilities that need very much further training such as: "Make electric fence controller safe," "Prevent electric shock," may need special bulletins and visual aids to be made for circulation.

4. The "Electricity at Work" TV program may use the findings to produce the needed supplementary teaching materials (films, kinescopes) and to circulate them to those teachers in the high schools.

5. A laboratory manual and/or handbook which covers the needed material in this finding would be very helpful to supplement the in-service training of the teachers.

Implications to other aspects of rural electrification education.--The findings and the method of investigation in the present study may be used in many other aspects of rural electrification education.

1. The findings in the present study are not limited to determining the course content for the preparation of the teachers of agriculture in Michigan; they may be used by some of the seven groups to plan their rural electrification education programs. For instance, the instructor of the short course students might study the ratings by the short course students, since the ratings reflect the needs and interest of that group. The teachers of agriculture may check the abilities, in order of importance, as rated by the composite, with the high school students, adult and young farmers to plan the courses to meet the needs of each group.

The agricultural engineers, the leaders in teacher education, the rural servicemen, the safety specialist, the Michigan Committee on Rural Electrification and others who are associated with rural electrification education may use the findings in the present study to put more emphasis on abilities that need special attention, for instance, the abilities in the sub-area safety.

2. The method of investigation in the present study is recommended for determining the course content for high school students, farmers' classes in rural electrification or farm mechanics. The composite opinion is more representative than the opinion of one group.

Suggested Research in Rural Electrification Education

To compare with the voluminous studies in farm mechanics, very few investigations have been made in the field of rural electrification. The present study is limited to the state of Michigan and the survey was done in 1959. Many other phases of investigation in rural electrification are needed as follows:

1. To keep the instruction vital and current, it is recommended that a periodic check be made of the abilities needed in the course content for the preparation of prospective teachers as well as to plan in-service training for the teachers in the high schools.

2. To ascertain the abilities in rural electrification that will be needed by the high school students, young and adult farmers. The check-list used in the present study, with revisions needed, may be important in developing a farm experience inventory as well as setting up courses in rural electrification for high school students and farmers in various communities.

3. To investigate the needs, interests and problems that many teachers may have in securing teaching materials in rural electrification, such as books, bulletins, workbook manuals, magazines, and visual aids so that they will have better in-service education.

4. To study the facilities, laboratory and shop

equipment and teaching materials that will be needed in the high schools for carrying out an adequate program in rural electrification education.

5. To study the reasons of variations in correlations. For instance, it was found that the frequency of teaching an ability in high schools was related to the degree of importance and the adequacy of training the teachers rated on that ability. However, the training of the ability, "Compute monthly bills from meter and rate schedule," was rated much higher than the importance and application. On the other hand, the teachers rated the safety abilities much higher than training and application. No information was obtained on the reasons why there were such variations.

Again, it was inferred that agricultural engineers are less concerned than the other six groups with safety abilities. This inference needs to be tested.

6. Why was it that the leaders in teacher education and the teachers of agriculture rated the total abilities much higher than the farmers' groups? (Is this true in other areas of farm mechanics? It needs further investigation.)

7. Cooperative investigation of the changing needs of the teachers of agriculture and the farmers in the area of rural electrification is needed in Michigan. In Ohio, the power suppliers cooperated with the university and the teachers of agriculture and farmers to study their common

problems. They exchanged ideas and teaching materials. The Michigan Committee on Rural Electrification may promote further coordination to pool the ideas for promoting the rural electrification education in Michigan.

A SELECTED BIBLIOGRAPHY

(This bibliography contains the literature cited in this study and other materials which were particularly pertinent to this study.)

Books

Brown, Robert H., Farm Rural Electrification. New York: McGraw-Hill Book Co., Inc., 1956.

Cook, G. C., Scranton, L. L., and McColly, H. F., Farm Mechancis Text and Handbook. Danville, Illinois: The Interstate, 1946.

Cook, G. C., Walker, Clyde, Snowden, O. L., Practical Methods in Teaching Farm Mechanics. Third edition. Danville, Illinois: The Interstate, 1947.

Croxton, F. E. and Cowden, D. J., Applied General Statistics. Englewood Cliffs, New Jersey: Prentice Hall, Inc., second edition, 1960.

Dixon, W. J. and Massey, F. J., Introduction to Statistical Analysis. New York: McGraw-Hill Book Co., 1957.

Richter, H. P., Wiring Simplified. Minneapolis, Minnesota: Park Publishing Co., 1947.

Snedecor, George, W., Statistical Methods, The Iowa State College Press, Ames, Iowa, fifth edition, 1956.

Wright, F. B., Electricity in the Home and on the Farm. New York: John Wiley & Sons, Inc., third edition, 1950.

Bulletins, Manuals and Reports

"Agricultural Engineering Phases of Teacher Training for Vocational Agriculture," A Report of the Subcommittee on Agricultural Teacher Training, Committee on Curriculum, (College Division), American Society of Agricultural Engineers, in Collaboration with Advisory Group of Agricultural Education Specialists, June 22, 1944, Washington, American Society of Agricultural Engineers, 1944.

_____. 1953.

Handbook for Effective Teaching of Farm Mechanics in the Vocational Agricultural Departments of Louisiana. Bulletin No. 671, Baton Rouge, Louisiana: State Department of Education, 1949.

Michigan Consumers Power Company, How Electricity Came to 100,000 Michigan Farm Customers of Consumers Power Company. Special Bulletin, Jackson, Michigan: Consumers Power Company, 1949.

McClay, D. R.; Anthony, F.; Jones, R. N.; and Oliver, E. F., Lessons on Wiring. Miscellaneous Publication No. 2. Pennsylvania State University, State College, Pennsylvania, 1954.

State Department of Agricultural Education, Farm Electric Demonstration Manual for Vocational Agriculture Instruction, State Department of Agricultural Education, St. Paul, Minn., 1958.

Summaries of Studies in Agricultural Education, Vocational Education Bulletin 180, including supplements Nos. 1 to 14 which list studies through the 1959-60 academic year. Washington, D.C.: U. S. Office of Education.

U. S. Department of Agriculture, Rural Electrification Administration Annual Statistical Report, 1959.

_____. 1960.

Periodicals

Cook, Glen C., "Safety Precautions in Farm Mechanics in Shops," The Agricultural Education Magazine, 13:13 July, 1941.

Dickinson, Sherman, "A Survey of Instruction in Farm Shop," Special Study, Univ. of Missouri, Columbia, The Agricultural Education Magazine, 4:170, 1932.

Duncan, David B., "Multiple Ranges and Multiple F test," Biometric, 11:1-41, March, 1955.

Jones, Floyd, "What Are Your Members Thinking About?" Rural Electrification News, pp. 1-11, March, 1952.

London, H. H., "Education, the Key to Improved Use of Electricity On the Farm." The Agricultural Education Magazine, 20:196-197, April, 1948.

Price, H. L., "Planning Instruction on Rural Electrification," The Agricultural Education Magazine, 12:235, June, 1940.

Wakeman, T. J., "Teach Farm Electricity by Example and Demonstration," Better Farming Methods, p. 83, May, 1951.

Walker, Clyde, "Rural Electrification in Vocational Agriculture," The Agricultural Education Magazine, 12:12, July, 1939.

Unpublished Materials

Abbott, Charles F. "What Are the Activities Which Should Be Included in An Effective Summer Program of Work For A Teacher of Vocational Agriculture in New York?" Unpublished Master's thesis, Cornell Univ., Ithaca, 1957.

Berry, Melvin T. "Practices and Opinions of Teachers in Area VIII of Texas Concerning the Teaching of Rural Electrification." Unpublished Master's Problem, Sam Houston State Teachers' College, Huntsville, Texas, 1952.

Blackman, Albert Ernest. "A Suggested Farm Mechanics Training Program for Prospective Teachers of Vocational Agriculture in Louisiana." Unpublished Master's Thesis, Louisiana State Univ., Baton Rouge, Louisiana, 1954.

Birdwell, Raymond S. "A Study of the Use of Electricity by Farmers in the Sherman Community." Unpublished Master's Research Problem. Texas A. & M. College, College Station, Texas, 1953.

Bollwahn, Lester Paul. "A Self Evaluation of Abilities in Farm Mechanics by Short Course Students in Agricultural Colleges with Implications for Instructional Program." Unpublished Doctor's Thesis, Michigan State Univ., East Lansing, 1961.

Campbell, J. L. "Universal Shop Procedures for Vocational Agriculture." Unpublished Master's Thesis, Univ. of Missouri, Columbia, 1926.

Carnie, G. M. "Evaluation of the Pre-Service Training of Vocational Agriculture Instructors in Farm Mechanics." The Univ. of Idaho, Moscow, 1959.

Chilen, P. R. "Farm Operator Evaluations of the Farm Mechanics Phases of Agricultural Engineering at Texas College of Arts and Industries, Kingsville, Texas." Unpublished Master's Report, Kansas State College, Manhattan, Kansas, 1952.

Cook, Glen C. and Byram, Harold M. "Mechanical Activities of Selected Farmers in Michigan." Non-thesis Study, Michigan State Univ., East Lansing, Michigan, 1952.

Curtis, C. M. "A Suggested Course of Study in Farm Electrification for Teachers of Vocational Agriculture in Louisiana." Unpublished Master's Thesis, Louisiana State Univ., Baton Rouge, Louisiana, 1952.

Cushman, Harold R. "How Can the Agricultural Engineering Needs of Present and Prospective Teachers of Vocational Agriculture in Vermont Be Met?" Unpublished Non-thesis Study, Cornell Univ., Agricultural Education Department, Univ. of Vermont, Burlington, Vermont, 1951.

Davis, L. R. "Farm Shop Work in Vocational Education." Unpublished Master's Thesis, Colorado Agricultural College, Fort Collins, 1923.

Dougan, R. S. "Farm Shop Skills and Abilities Needed and Acquired by Beginning Teachers of Vocational Agriculture in Ohio." Unpublished Master's Thesis, The Ohio State Univ., Columbus, 1951.

Dugger, W. R. "Mechanical Competencies Needed by Vocational Agriculture Teachers in Oklahoma." Unpublished Doctor's Thesis, Oklahoma Agricultural and Mechanical College, Stillwater, 1956.

Hamilton, James Roland. "The Preparation of Michigan Teachers of Vocational Agriculture in Two Areas of Farm Mechanics." Unpublished Doctor's Thesis, Michigan State Univ., East Lansing, Michigan, 1955.

Hartzog, D. H. "A Study of the Effect of a Survey of Farmer Opinion on Course of Study in Farm Mechanics." Unpublished Doctor's Thesis, University of Minnesota, Minneapolis, 1959.

Horne, T. J. "Participation of Power Suppliers in the Educational Program of Land Grant Colleges." Non-thesis Study, Blacksburg, Virginia Polytechnic Institute, 1951.

Hutson, D. B. "Instruction in Farm Mechanics as Conducted by Teachers of Vocational Agriculture in Arkansas." Unpublished Non-thesis Study, Univ. of Arkansas, Fayetteville, Arkansas, 1955.

Hutson, D. B. and Ekstrom, G. F. "A Study of the Training Needs for Prospective Teachers of Vocational Agriculture." Unpublished Non-thesis Study, Univ. of Missouri, Columbia, 1952.

Jackson, R. C. "A Study of the Use of Electricity by 43 Farm Families in Rosebud, Texas." Unpublished Master's Report, Agricultural and Mechanical College of Texas, College Station, Texas, 1956.

Jacobs, C. O. "Determining the Need for a Program of Instruction in Farm Mechanics for College Students Based upon a Survey of Farm Operator Performance." Unpublished Master's Report, Kansas State College, Manhattan, Kansas, 1953.

Larson, Marvin E. "A Study to Determine the Technical Abilities Needed in the Farm Mechanics Curriculum of Agricultural Education Majors in Pre-Service Training." Unpublished Master's Thesis, South Dakota State College, Brookings, 1959.

Longhurst, M. A. "A Study of the Farm Mechanics Curriculum with Recommendations for the Teacher Training Institutions." Unpublished Seminar Report, M. Edu., Utah State Univ. of Agriculture and Applied Science, Logan, Utah, 1959.

Matthews, J. W. "Basic Issues in Farm Mechanics Education With Implications for the Pre-Service Education of Teachers of Vocational Agriculture." Unpublished Doctor's Thesis, Univ. of Illinois, Urbana, 1957.

Odell, Finley. "The Farm Mechanics Skills Used by Vocational Agriculture Teachers in 40 Vocational Agriculture Departments in West Virginia." Unpublished Master's Problem, West Virginia Univ., Morgantown, West Virginia, 1955.

Pfister, Richard G. "A Study to Determine How Important Various Farm Mechanics Skills Are to Successful Farmers in the Imlay City Community, Michigan." Unpublished Master's Problem, Michigan State College, East Lansing, Michigan, 1953.

Rhoad, C. E. "A Study of the Comprehensiveness of Abilities in Technical Agriculture Attained by Prospective Teachers of Vocational Agriculture in Ohio Previous to Their Entrance into Student Teaching." Unpublished Doctor's Thesis, Ohio State Univ., Columbus, 1943.

Rogers, M. S. "A Proposed Course of Study for Farm Mechanics in Vocational Agriculture in the Northeast Texas Area." Unpublished Doctor's Thesis, Utah State Univ., Logan, 1957.

Ryder, G. J. "Preparation in Farm Mechanics Education for Teachers of Vocational Agriculture." Unpublished Doctor's Thesis, The Ohio State Univ., Columbus, Ohio, 1954.

Schafer, W. A. "Teaching Units in Farm Mechanics for Courses of Study in Arizona Departments of Vocational Agriculture." Unpublished Master's Thesis, Univ. of Arizona, Tuscon, Arizona, 1951.

Sneep, Neil Owen. "Improving the Teaching of Farm Electrification in Vocational Agriculture in Ohio." Unpublished Master's Thesis, The Ohio State Univ., Columbus, Ohio, 1957.

Shih, Samuel H. K. "Physical Hazards to Safe Living on 688 Iowa Farms." Unpublished Master's Thesis, Iowa State College, Ames, Iowa, 1955.

Stuckey, W. E. "The Present Program and Needs for In-Service Education in Farm Mechanics for Teachers of Vocational Agriculture in Ohio." Non-thesis study, The Ohio State Univ., Columbus, Ohio, 1956.

Thompson, C. T. "Farm Shop Jcbs for Louisiana." Unpublished Master's Thesis, Louisiana State Univ., Baton Rouge, Louisiana, 1938.

Watkins, John W. "Farm Mechanics Program and Facilities for Vocational Agriculture in Ohio." Unpublished Master's Thesis, The Ohio State University, Columbus, Ohio, 1959.

Wells, G. L. "A Survey of the Aspects of Teaching Rural Electrification in Vocational Agriculture in South Dakota." Unpublished Master's Problem, South Dakota State College, Brookings, South Dakota, 1958.

APPENDICES

APPENDIX A

Form A

CHECK LIST ON ABILITIES IN RURAL ELECTRIFICATION NEEDED BY MICHIGAN TEACHERS OF AGRICULTURE

DIRECTIONS---Please check each of the following suggested abilities for the preparation of Michigan teachers of agriculture in rural electrification on:

(1) How important you feel each ability is needed in your teaching.
(2) How adequate was your college training in each ability.
(3) Whether you taught the ability.

Abilities*	As preparation for teaching I regard this ability as:			The training I received at college in this ability was:			Have you taught this ability ?	
	1	2	3	4	5	6	7	8
	very important	fairly important	relatively unimportant	adequate	fairly adequate	inadequate	yes	no
I. BASIC ABILITIES--The ability to:								
1. compute monthly bills from meter & rate schedule (1) 1								
2. select electrical appliances for convenience, economy, and safety. (2) 2								
3. compare cost of electricity with other sources of power. (3) 3								
4. compute energy consumption of various appliances (as: range, welder...) (4) 4								
5. recognize sources of reliable information on rural electrification. (5) 5								
6. comply with electrical code and select Underwriters Laboratory approved materials. (6) 6								
7. determine types and sizes of fuses for protection (7) 7								
8. locate hazards such as short or open circuits. (8) 8								
9. repair damaged cords and make proper splices. (9) 9								
10. install time clock switch, thermostatic switch. (10) 10								
11. install remote controls. (11) 11								
12. charge storage battery. (12) 12								
II. WIRING HOME & FARMSTEAD--The ability to:								
1. plan wiring system for present & future loads. (13) 1								
2. locate load center & distribution center. (14) 2								
3. select wiring materials (types, sizes...) (15) 3								
4. select service-entrance switches. (16) 4								
5. determine number of branch circuits in new bldgs (17) 5								
6. locate outlets and switches. (18) 6								
7. install 3-way & 4-way switches. (19) 7								
8. wire a circuit for general purpose lights & outlets. (20) 8								
9. wire a circuit for special outlets (as: range, welder...) (21) 9								
10. use judgment to revise present wiring system. (22) 10								

*The term "ability" as used here, implies adequate understanding and performance

APPENDIX A - Continued

	1 very important	2 fairly important	3 relatively unimportant	4 adequate	5 fairly adequate	6 inadequate	7 yes	8 no
II. MOTORS--The ability to:								
1. select proper types and sizes of motors (23) 1								
2. select proper overload protection. (24) 2								
3. clean and lubricate motors. (25) 3								
4. change direction or rotation of motor. (26) 4								
5. change voltage of dual voltage motor. (27) 5								
6. replace motor brushes. (28) 6								
7. interpret motor nameplate information. (29) 7								
8. select pulleys and belts for machine of desired speed. (30) 8								
9. mount motor and adjust belt tension. (31) 9								
10. ~~use 3 phase motors~~. 10								
IV. LIGHTING FOR HOME & FARM--The ability to:								
1. recognize effects of poor lighting in quantity and quality. (32) 1								
2. determine light requirements for various areas and jobs. (33) 2								
3. determine voltage drop & its effect on lighting (34) 3								
4. select lighting equipment for home and yards. (35) 4								
5. install light fixtures. (36) 5								
V. HEATING, COOLING & ELECTRICAL EQUIPMENT--The ability to:								
1. install heat lamps for pig or chicken brooding (37) 1								
2. determine cost of heating home with electricity (38) 2								
3. calculate heat in BTU's which must be removed to cool farm products. (39) 3								
4. determine water requirements in gallons per hour for home and farmstead. (40) 4								
5. install air conditioner at home. (41) 5								
I. SAFETY, LIGHTNING & FIRE--The ability to:								
1. ground equipment & wiring system safely. (42) 1								
2. make electric fence controller safe. (43) 2								
3. install fire-proof lighting fixture in hayloft properly. (44) 3								
4. prevent electric shock. (45) 4								
5. use fire fighting equipment for electric fires. (46) 5								
6. recognize hazards of substandard wiring. (47) 6								
7. protect buildings from hazards of lightning (48) 7								
8. use ultraviolet lamp & other special lamps safely (49)								

School _____

Teacher of Agriculture _____

APPENDIX B

CHECK LIST ON ABILITIES IN RURAL ELECTRIFICATION NEEDED BY MICHIGAN TEACHER OF AGRICULTURE

Form B

Abilities*	As preparation for teachers of agriculture, I regard this ability as: 1 very important	2 fairly important	3 relatively unimportant
*The term "ability" as used here, implies adequate understanding and performance			
I. BASIC ABILITIES--The ability to:			
1. compute monthly bills from meter and rate schedule (1)			
2. select electrical appliances for convenience, economy, and safety (2)			
3. compare cost of electricity with other sources of power. (3)			
4. compute energy consumption of various appliances (as: range, welder...) (4)			
5. recognize sources of reliable information on rural electrification. (5)			
6. comply with electrical code and select Underwriters' Laboratory approved materials. (6)			
7. determine types and sizes of fuses for protection. (7)			
8. locate hazards such as short or open circuits. (8)			
9. repair damaged cords and make proper splices. (9)			
10. install time clock switch, thermostatic switch. (10)			
11. install remote controls. (11)			
12. charge storage battery. (12)			
II. WIRING HOME & FARMSTEAD--The ability to:			
1. plan wiring system for present & future loads. (13)			
2. locate load center & distribution center. (14)			
3. select wiring materials (types, sizes...) (15)			
4. select service-entrance switches. (16)			
5. determine number of branch circuits in new buildings. (17)			
6. locate outlets and switches. (18)			
7. install 3-way & 4-way switches. (19)			
8. wire a circuit for general purposes lights & outlets. (20)			
9. wire a circuit for special outlets (as: range, welder...) (21)			
10. use judgment to revise present wiring system. (22)			
III. MOTORS--The ability to:			
1. select proper types and sizes of motors. (23)			
2. select proper overload protection. (24)			
3. clean and lubricate motors. (25)			
4. change direction of rotation of motor. (26)			
5. change voltage of dual voltage motor. (27)			
6. replace brushes. (28)			
7. interpret motor nameplate information. (29)			
8. select pulleys and belts for machine of desired speeds. (30)			
9. mount motor and adjust belt tension. (31)			

APPENDIX B - Continued

		1 very important	2 fairly important	3 relatively unimportant
IV.	LIGHTING FOR HOME & FARM--The ability to:			
	1. recognize effects of poor lighting in quantity and quality. (32)	1		
	2. determine light requirements for various areas and jobs. (33)	2		
	3. determine voltage drop and its effect on lighting. (34)	3		
	4. select lighting equipment for home and yards. (35)	4		
	5. install light fixtures (36)	5		
V.	HEATING, COOLING & ELECTRICAL EQUIPMENT--The ability to:			
	1. install heat lamps for pig or chicken brooding. (37)	1		
	2. determine cost of heating home with electricity. (38)	2		
	3. calculate heat in BTU's which must removed to cool farm products (39)	3		
	4. determine water requirements in gallons per hour for home and farmstead (40)	4		
	5. install air conditioner (41)	5		
VI.	SAFETY, LIGHTNING & FIRE--The ability to:			
	1. ground equipment & wiring system safely. (42)	1		
	2. make electric fence controller safe. (43)	2		
	3. install fire-proof lighting fixture in hayloft properly. (44)	3		
	4. prevent electric shock. (45)	4		
	5. use fire fighting equipment for electric fires. (46)	5		
	6. recognize hazards of substandard wiring. (47)	6		
	7. protect buildings from hazards of lightning. (48)	7		
	8. use ultraviolet lamp & other special lamps safely. (49)	8		

Name _____

APPENDIX C

Geographic distribution of the 47 teachers of vocational agriculture in Michigan responding to check-list Form A.

No.	Name of School	County	Name of teacher
1.	Allegan*	Allegan	G. E. Elder
2.	Athens	Calhoun	J. P. Marzec
3.	Bath	Clinton	Jack Sanderson
4.	Bay City*	Bay	M. W. Brown, Jr.
5.	Berrien Springs	Berrien	A. G. Lange
6.	Breckenridge	Gratiot	C. W. Pelham
7.	Britton*	Lenawee	Jack Anderson
8.	Carleton Airport Community School	Monroe	F. P. Nevel
9.	Caro	Tuscola	C. R. Karelse
10.	Charlotte	Eaton	C. B. Ray
11.	Colon	St. Joseph	W. S. Wilson
12.	Edmore	Montcalm	A. E. Kohn
13.	Fennville*	Allegan	W. Gleason
14.	Fowlerville	Livingston	H. Elenbaas
15.	Gaines*	Genesee	J. D. Anibal
16.	Gaylord	Otsego	B. Schroeder
17.	Goodrich	Genesee	E. R. Noll
18.	Grand Ledge	Eaton	R. K. Richmond
19.	Hartland	Livingston	C. E. Hall

*Schools where farmer members of advisory councils were solicited as respondents.

APPENDIX C - Continued

No.	Name of School	County	Name of teacher
20.	Homer	Calhoun	Henry Noller
21.	Ithaca	Gratiot	C. M. Craybill
22.	Kinde*	Huron	J. W. Pelham
23.	Lakeview	Montcalm	R. J. Johnson
24.	Marshall	Calhoun	H. Gardner
25.	Marshall	Clahoun	R. Grossbaur
26.	Mason	Ingham	C. Rossman
27.	Mayville*	Tuscola	E. R. Cole
28.	Morenci	Lenawee	L. Spotts
29.	Okemos	Ingham	R. A. Cook
30.	Onsted*	Lenawee	N. H. Bless
31.	Owendale	Huron	J. B. Kreiner
32.	Owosso*	Shiawassee	D. W. Dalgleish
33.	Owosso*	Shiawassee	Raymond Hill
34.	Petoskey	Emmet	K. D. McAlvey
35.	Posen	Presque Isle	T. J. O'Conner
36.	Reading	Hillsdale	D. G. Leader
37.	Rudyard	Chippewa	L. G. Davis
38.	St. Charles	Saginaw	C. D. Nelson
39.	Saline	Washtenaw	A. F. Ealy

*Schools where farmer members of advisory councils were solicited as respondents.

APPENDIX C - Continued

No.	Name of School	County	Name of teacher
40.	Sandusky	Sanilac	L. F. Reuter
41.	Sebewaing	Huron	R. Pangman
42.	Tecumseh	Lenawee	P. F. Burns
43.	Temperance	Monroe	G. S. Struble
44.	Union City	Branch	D. P. Sackett
45.	Unionville	Tuscola	R. L. Colestock
46.	Vicksburg	Kalamazoo	K. L. Chichester
47.	Webberville	Ingham	W. C. Search

*School where farmer members of advisory councils were solicited as respondents. (Advisory council of Hopkins school also reported).

APPENDIX D

MICHIGAN STATE UNIVERSITY · East Lansing

College of Education · Department of Teacher Education

March 12, 1959

Dear Teachers:

I am doing research work under the direction of Dr. Byram, Dr. Clark, and Professor Wiant to determine the abilities in rural electrification needed by Michigan teachers of agriculture. We hope to get suggestions, based partly on your opinion and those of the farmers and the leaders in agricultural education for improving the content of the course in rural electrification. This should aid the preparation of Michigan teachers of agriculture both in our university and through in-service education.

From the professors at Michigan State University and Mr. H. E. Nesman, we have learned that you have a splendid farm mechanics program. We believe that your opinion regarding course content in rural electrification will be very valuable.

Enclosed are the check list and self-addressed and stamped envelope. Kindly fill out the check list as directed and send it back. We will appreciate your help and cooperation. A summary of the abilities in rural electrification needed by Michigan teachers of agriculture will be sent to you when this study has been completed.

Thank you very much.

Sincerely yours,

Samuel H.K. Shih

Samuel H.K. Shih, Graduate Student
Agricultural Education
Former Teaching Assistant
Agricultural Engineering Department

To Teachers of Agriculture--

I wish to commend Mr. Shih's inquiry to your attention. Previous studies of a similar nature have been made concerning other areas of farm mechanics. Your assistance by responding to this short check list will help the University in its efforts to improve curricula and instruction.

H. M. Byram

H. M. Byram, Professor
Agricultural Education

nb

Enclosures

MICHIGAN STATE UNIVERSITY East Lansing

APPENDIX E

College of Education · Department of Teacher Education

March 19, 1959

Dear Teacher:

I am doing research under the direction of Professors Byram, Clark, and Wiant to determine the abilities in electrification needed by Michigan teachers of agriculture. We hope to get suggestions, based partly on your opinion and those of farmers on your advisory council, for improving the content course in rural electrification for preparation of Michigan teachers of agriculture both pre-service and in-service.

From the professors at Michigan State University and Mr. H. E. Nesman, we have learned that you have a very active advisory council and a splendid farm mechanics program. We believe that your opinion regarding course content in rural electrification will be very valuable.

Two forms of a check list are enclosed. Form A is for you, the teachers, to check. You need only to check Form A as directed and send it back to me in the self-addressed and stamped envelope.

Form B is for the members of your advisory council to check. Please select five farmer members from your advisory council. I would like to suggest two points that might be helpful in selecting these members: (1) They are farmers and regular members of your advisory council, and have had one year's active participation. (2) Their opinion is valuable in the area of rural electrification.

Enclosed are five stamped envelopes which you can use to send Form B to the five members you will choose. Please address these envelopes to the farmer members you choose. After your members have checked the list, they should return the check list directly to me by the self-addressed, stamped envelope.

We will appreciate your help and cooperation. A summary of the study will be sent to you when this study has been completed. Thank you very much.

Sincerely yours,

Samuel H. K. Shih, Graduate Student
Agricultural Education
Former Teaching Assistant
Agricultural Engineering Department

To Teachers of Agriculture--

I wish to commend Mr. Shih's inquiry to your attention. Previous studies of a similar nature have been made concerning other areas in farm mechanics. Your assistance by responding to this short check list will help the University in its efforts to improve curricula and instruction.

H. M. Byram, Professor
Agricultural Education

nb
Enclosures

APPENDIX F

MICHIGAN STATE UNIVERSITY East Lansing

College of Education · Department of Teacher Education

March 19, 1959

Dear Member of the Advisory Council:

I am doing research work at Michigan State University to determine the abilities in rural electrification needed by Michigan teachers of agriculture. We hope to get suggestions, based partly on your opinion and those of the teachers of agriculture for improving the content of the University course in rural electrification. This should aid the preparation of Michigan teachers of agriculture both at our university and through in-service education.

I have learned that you have a very active advisory council and a splendid farm mechanics program in your school. We believe that your opinion regarding course content in rural electrification will be very valuable.

The teacher of vocational agriculture of your school would like to have you to serve as a member of the jury to check the enclosed check list. After filling it out, kindly use the self-addressed and stamped envelope to send it back to me.

Thank you very much.

Sincerely yours,

Samuel H. K. Shih, Graduate Student
Agricultural Education
Former Teaching Assistant
Agricultural Engineering Department

SHKS:nb

Enclosures

APPENDIX G

MICHIGAN STATE UNIVERSITY East Lansing

College of Education · Department of Teacher Education

March 19, 1959

Dear Sir:

I am doing research work under the direction of Professors Byram, Clark, and Wiant, all of Michigan State University, to determine the abilities in rural electrification needed by Michigan teachers in agriculture. We hope to get suggestions, based partly on your opinion and those of teachers of agriculture, for improving the content of the university course in rural electrification. This should aid the preparation of Michigan teachers of agriculture both in our university and through in-service education.

We believe that your opinion regarding rural electrification education will be very valuable. In order to obtain your opinion, I am enclosing a check list. Please check as directed and return it to me in the enclosed self-addressed and stamped envelope.

We will appreciate your help and cooperation. A summary of this study will be sent to you when it has been completed.

Thank you very much.

Sincerely yours,

Samuel Shih
Graduate Student
Agricultural Education

SS:nb

Enclosures

APPENDIX H

MICHIGAN STATE UNIVERSITY EAST LANSING

COLLEGE OF AGRICULTURE • DEPARTMENT OF AGRICULTURAL ENGINEERING

March 13, 1959

Dear Sir:

Mr. Sam Shih, one of our graduate students is making an attempt to determine what a vocational agriculture high school teacher should teach in the rural electrification field in order that high school students will get the necessary training to enable them to use more electricity effectively and efficiently.

We shall greatly appreciate it if you will take five minutes of your time and check the abilities on the attached questionnaire as your judgment dictates.

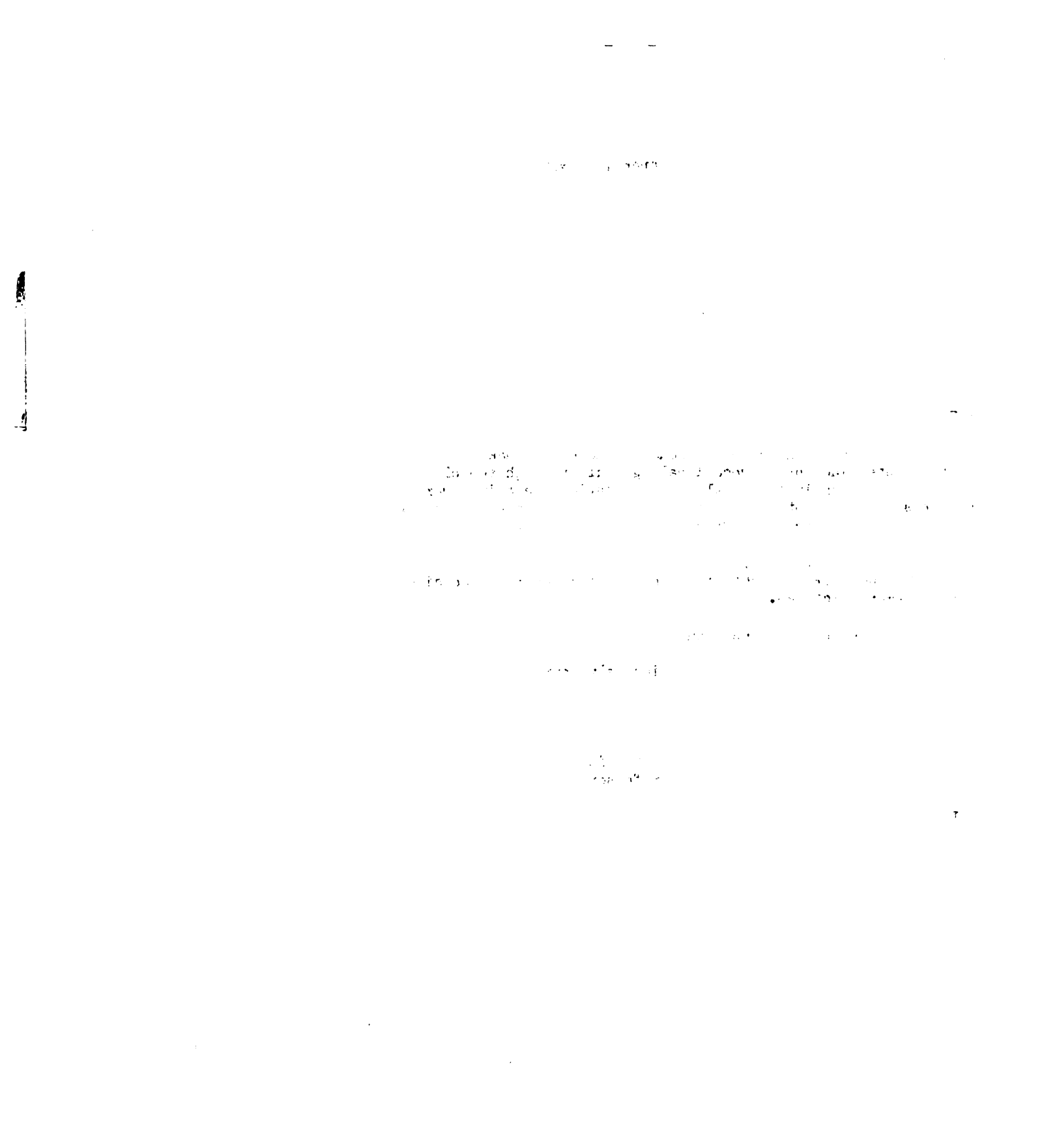
Please return the questionnaire to me.

Sincerely yours,

D E Wiant

D. E. Wiant
Professor

DEW:ct



APPENDIX I

Mean scores and ranks of the 49 abilities in rural electrification as reported by the composite and the seven groups in Michigan, 1959*

Sub-area and ability No.	Leaders in teacher education		Teachers of agriculture		Prospective teachers		Agricultural engineers		Rural servicemen	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
I. Basic Abilities										
1.	1.37	8	1.00	10	0.92	10	1.33	8.5	1.00	9
2.	1.53	7	1.28	7	1.64	4	1.60	6	1.54	5.5
3.	1.58	6	1.30	6	1.72	2.5	1.53	7	1.59	3.5
4.	1.26	9	1.17	8	1.48	6	1.33	8.5	1.39	7
5.	1.84	3	1.47	5	1.44	7	1.80	2.5	1.54	5.5
6.	1.74	4	1.74	4	1.60	5	1.80	2.5	1.61	2
7.	1.95	1	1.91	1	1.80	1	1.93	1	1.93	1
8.	1.89	2	1.85	3	1.72	2.5	1.73	4	1.59	3.5
9.	1.68	5	1.87	2	1.40	8	1.67	5	1.36	8
10.	1.05	10	1.00	10	0.60	11	0.93	10	0.82	10
11.	0.89	11	0.57	12	0.52	12	0.73	11.5	0.57	11
12.	0.68	12	1.00	10	1.00	9	0.73	11.5	0.39	12
Sub-area	1.46	5	1.35	5	1.32	5	1.43	5	1.27	5

*The seven groups and composite columns are on mean scores of importance, and the last two columns are mean scores of training and application reported by 47 teachers.

APPENDIX I - Continued

Sub-area and ability number	Farmers in advisory councils		Young farmers		Composite		Adequacy of training		Frequency of application	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
I. Basic Abilities										
1.	1.06	9	1.00	9	1.06	9	1.38	3	1.36	6
2.	1.63	4	1.58	5	1.52	5	0.87	9	1.32	7
3.	1.47	5.5	1.26	7	1.44	7	0.98	8	1.40	4.5
4.	1.19	7	0.96	10	1.21	8	1.17	6	1.28	8
5.	1.13	8	1.38	6	1.46	6	1.11	7	1.15	9
6.	1.47	5.5	1.66	4	1.65	4	1.28	4	1.62	3
7.	1.88	1	1.82	1.5	1.88	1	1.47	2	1.83	1.5
8.	1.69	2	1.82	1.5	1.76	2	1.26	5	1.40	4.5
9.	1.67	3	1.74	3	1.66	3	1.64	1	1.83	1.5
10.	1.00	10	0.68	11	0.86	11	0.57	11	0.43	11
11.	0.81	11	0.54	12	0.63	12	0.32	12	0.17	12
12.	0.72	12	1.14	8	0.87	10	0.75	10	0.85	10
Sub-area	1.31	5	1.30	4	1.33	5	1.07	3	1.22	4

APPENDIX I - Continued

Sub-area and ability number	Leaders in teacher education		Teachers of agriculture		Prospective teachers		Agricultural engineers		Rural servicemen	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
II. Wiring home and farmstead										
1.	1.58	3	1.62	6	1.68	2	1.80	1	1.79	1
2.	1.23	9	1.34	10	1.60	4	1.33	8	1.57	4.5
3.	1.79	1	1.77	2	1.76	1	1.60	4.5	1.64	3
4.	1.37	8	1.49	8	1.48	7.5	1.07	9.5	1.57	4.5
5.	1.53	5.5	1.60	7	1.60	4	1.53	6	1.46	6
6.	1.58	3	1.72	3.5	1.52	6	1.73	2	1.43	7
7.	1.47	7	1.72	3.5	1.48	7.5	1.60	4.5	1.04	10
8.	1.58	3	1.79	1	1.40	9	1.67	3	1.29	8
9.	1.05	10	1.47	9	1.28	10	1.07	9.5	1.14	9
10.	1.53	5.5	1.64	5	1.60	4	1.47	7	1.71	2
Sub-area	1.47	4	1.61	2	1.54	3	1.49	4	1.46	2

APPENDIX I - Continued

Sub-area and ability number	Farmers in advisory councils		Young farmers		Composite		Adequacy of training		Frequency of application	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
II. Wiring home and farmstead										
1.	1.67	1	1.76	1	1.69	1	1.23	5	1.49	5
2.	1.34	5	1.48	5	1.41	7	0.98	8.5	1.11	10
3.	1.56	2	1.64	2	1.68	2	1.32	3	1.87	1
4.	1.22	9	1.48	5	1.42	8	0.98	8.5	1.40	6
5.	1.31	7	1.48	5	1.50	6	1.11	6	1.28	7
6.	1.31	7	1.46	7.5	1.53	5	1.28	4	1.70	3
7.	1.03	10	1.44	9	1.41	9	1.38	2	1.53	4
8.	1.41	4	1.56	3	1.54	4	1.49	1	1.79	2
9.	1.31	7	1.42	10	1.31	10	1.04	7	1.19	9
10.	1.53	3	1.46	7.5	1.57	3	0.94	10	1.23	8
Sub-area	1.37	3	1.52	2	1.51	2	1.17	1	1.46	1

APPENDIX I - Continued

Sub-area and ability number	Leaders in teacher education		Teachers of agriculture		Prospective teachers		Agricultural engineers		Rural servicemen	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
III. Motors										
1.	1.95	1.5	1.91	1	1.72	2	1.93	1.5	1.89	1
2.	1.84	3	1.79	3.5	1.64	4.5	1.87	3	1.86	2
3.	1.74	5.5	1.79	3.5	1.56	7	1.60	5.5	1.39	6
4.	1.37	8	1.30	8	1.64	4.5	1.60	5.5	1.04	8
5.	1.11	9	1.06	9	1.52	8	1.53	7.5	1.14	7
6.	1.58	7	1.38	7	1.00	9	1.13	9	0.89	9
7.	1.79	4	1.83	2	1.76	1	1.80	4	1.75	3
8.	1.74	5.5	1.77	5	1.68	3	1.93	1.5	1.61	4
9.	1.95	1.5	1.60	6	1.60	6	1.53	7.5	1.43	5
Sub-area	1.67	2	1.60	3	1.57	2	1.66	1	1.44	3

APPENDIX I - Continued

Sub-area and ability number	Farmers in advisory councils		Young farmers		Composite		Adequacy of training		Frequency of application	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
III. Motors										
1.	1.81	1	1.68	1	1.82	1	1.15	5	1.49	5
2.	1.50	4.5	1.54	2	1.69	2	1.09	6	1.19	6.5
3.	1.41	6	1.36	4.5	1.54	5	1.19	4	1.53	4
4.	1.22	7	1.08	7.5	1.27	7	0.94	7	1.19	6.5
5.	0.97	9	0.94	9	1.12	9	0.64	9	0.55	9
6.	1.09	8	1.08	7.5	1.16	8	0.83	8	1.02	8
7.	1.63	3	1.36	4.5	1.67	3	1.34	1	1.75	1
8.	1.78	2	1.38	3	1.66	4	1.23	2.5	1.57	3
9.	1.50	4.5	1.16	6	1.49	6	1.23	2.5	1.70	2
Sub-area	1.43	2	1.29	5	1.49	3	1.07	2	1.33	2

APPENDIX I - Continued

Sub-area and ability number	Leaders in teacher education		Teachers of agriculture		Prospective teachers		Agricultural engineers		Rural servicemen	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
IV. Lighting for Home and Farm										
1.	1.79	1	1.60	2	1.84	1	1.93	1	1.86	1
2.	1.68	2	1.40	5	1.60	2	1.60	2	1.61	2
3.	1.53	4	1.49	4	1.24	5	1.27	5	1.32	4
4.	1.58	3	1.51	3	1.56	3	1.53	3	1.57	3
5.	1.37	5	1.64	1	1.28	4	1.33	4	0.82	5
Sub area	1.59	3	1.53	4	1.50	4	1.53	3	1.41	4
V. Heating and Cooling										
1.	1.84	1	1.91	1	1.52	1	1.53	1	1.54	1
2.	1.16	2	0.72	3	1.12	3	0.67	3.5	0.93	4
3.	0.68	4	0.57	4	1.00	4	0.67	3.5	1.07	3
4.	1.11	3	1.09	2	1.16	2	1.20	2	1.25	2
5.	0.32	5	0.51	5	0.48	5	0.33	5	0.43	5
Sub-area	1.02	6	0.96	6	1.06	6	0.88	6	1.04	6

APPENDIX I - Continued

Sub-area and Ability number	Farmers in advisory councils		Young farmers		Composite		Adequacy of training		Frequency of application	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
IV. Lighting for Home and Farm										
1.	1.34	2.5	1.56	2	1.65	1	1.00	4	1.19	3
2.	1.22	5	1.32	4	1.44	3	0.79	5	0.60	5
3.	1.31	4	1.08	5	1.31	5	1.11	2	1.02	4
4.	1.35	1	1.34	3	1.45	2	1.02	3	1.32	2
5.	1.34	2.5	1.58	1	1.39	4	1.28	1	1.70	1
Sub-area	1.32-	4	1.38	3	1.45	4	1.04	4	1.17	5
V. Heating, cooling and electrical equipment										
1.	1.56	1	1.26	1	1.58	1	1.36	1	1.92	1
2.	0.91	3	0.92	2	0.90	3	0.68	2	0.34	3
3.	0.81	4	0.64	5	0.76	4	0.34	4	0.13	4
4.	1.28	2	0.84	3	1.10	2	0.62	3	0.38	2
5.	0.34	5	0.66	4	0.48	5	0.19	5	0.09	5
Sub-area	0.98	6	0.86	6	0.96	6	0.64	6	0.57	6

APPENDIX I - Continued

Sub-area and ability number	Leaders in teacher education		Teachers of agriculture		Prospective teachers		Agricultural engineers		Rural servicemen	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
VI. Safety, Lightning and fire										
1.	1.95	2	1.89	2.5	1.88	2.5	2.00	1	1.82	3
2.	1.89	3.5	1.89	2.5	1.76	5	1.47	6	1.75	4.5
3.	1.84	5	1.81	6	1.72	6	1.53	4.5	1.75	4.5
4.	1.79	6	1.74	7	1.85	2.5	1.93	2	1.86	2
5.	1.89	3.5	1.87	4	1.84	4	1.53	4.5	1.71	6
6.	2.00	1	1.91	1	2.00	1	1.87	3	1.96	1
7.	1.58	7	1.85	5	1.64	7	1.13	8	1.43	8
8.	1.32	8	1.26	8	1.48	8	1.27	7	1.57	7
Sub-area	1.78+	1	1.78-	1	1.78-	1	1.59	2	1.73	1

49 Abilities					
Grand mean	1.52	1.50	1.48-	1.46+	1.41
Rank among 7 groups	1	2	3	4	5

APPENDIX I - Continued

Sub-area and ability number	Farmers in advisory councils		Young farmers		Composite		Adequacy of training		Frequency of application	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
VI. Safety, lightning and fire										
1.	1.91	1	1.76	1	1.87	1	1.15	2	1.70	2
2.	1.75	4.5	1.52	7	1.72	6	0.92	7	1.06	6
3.	1.88	2	1.70	2	1.76	4	1.11	3	0.98	7
4.	1.78	3	1.66	3	1.78	3	1.09	4	1.40	3.5
5.	1.75	4.5	1.54	6	1.75	5	0.94	6	1.32	5
6.	1.67	6	1.62	5	1.83	2	1.19	1	1.79	1
7.	1.50	7	1.64	4	1.60	7	1.02	5	1.40	3.5
8.	1.25	8	1.24	8	1.32	8	0.70	8	0.60	8
Sub-area	1.68	1	1.59-	1	1.70	1	1.01	5	1.28	3
49 abilities										
Grand mean of each group	1.37		1.35		1.43		1.03		1.23	
Rank among 7-groups	6		7		-					