THE PREPARATION OF MICHIGAN TEACHERS OF VOCATIONAL AGRICULTURE IN TWO AREAS OF FARM MECHANICS

Thesis for the Degree of Ed. D.

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James Roland Hamilton

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THESIS

This is to certify that the

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The Preparation of Michigan Teachers of Vocational Agriculture in two Areas of Farm Mechanics

presented by

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Doctor's degree in Education

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THE PREPARATION OF MICHIGAN TEACHERS OF VOCATIONAL AGRICULTURE IN TWO AREAS OF FARM MECHANICS

By

James Roland Hamilton

AN ABSTRACT

Submitted to the School of Graduate Studies of Michigan State University of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

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<u>Purpose</u>. To establish a basis for instructional planning in two areas of farm mechanics for the preparation of Michigan teachers of vocational agriculture by: making an assessment of the relative importance of farm-shop and farm-structures abilities needed in teaching vocational agriculture in Michigan; and by evaluating the adequacy of the instruction received by teachers in these abilities.

<u>Method</u>. Agricultural engineers collaborated in preparing two lists consisting of: 110 farm-shop abilities, and seventy farm-structures abilities. The importance of these items in teaching vocational agriculture was rated by: fourteen agricultural engineers at Michigan State University, sixteen persons in teacher education in Michigan, eighty Michigan teachers of vocational agriculture, and forty-two farmer members of advisory councils. The adequacy of training was checked by eighty teachers of vocational agriculture. Score values were assigned for three different degrees of importance and training.

<u>Findings and interpretations.</u> (1) There was general agreement among the four groups in regard to the importance of 180 farm-mechanics abilities. (2) The importance of farm-mechanics abilities in teaching vocational agriculture was rated highest in the units of: general principles, use and care of tools, arc welding, and concrete-masonry; the importance was scored lowest in forge work, sheet-metal, cold-metal,

painting, and related-woodwork abilities. (3) The training was rated as most adequate in sheet-metal, cold-metal, rope-work, tool-care, and concrete-masonry abilities; the training was checked as least adequate in the units of pipe fitting, oxy-acetylene welding, forge work, repairing farm structures, and related woodwork. (4) Correlation tables revealed that the harmony between the importance and training indices could be improved by increasing the instructional emphasis in the units of: general principles, use and care of tools, pipe fitting, and repairing farm structures; the data indicated that decreases in the instructional emphasis were needed in rope, sheet-metal, and concrete-masonry abilities.

The managerial abilities were rated higher in importance and lower in adequacy of training than were the manipulative type.

As a means of further development of abilities in college training teachers suggested: increasing field trips and project construction, adding activities in planning shops, and increasing activities in tool processes; teachers reported that farm background and teaching practice were valuable as supplementary experiences in improving farm-mechanics abilities.

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CHAPTER I

INTRODUCTION

This study pertains to the problem of the preparation of Michigan teachers of vocational agriculture in two areas of farm mechanics. The major phases of the problem are presented in the following order: (1) definition of the problem, (2) basic assumptions made, (3) scope and limitations of the study, (4) definition of terms used, and (5) background of the problem.

Definition of the Problem

Since the early years in the history of vocational education in agriculture farm mechanics has been recognized as an essential phase of the instruction. The continuing increase in the mechanization of agriculture and the trend toward the use of more power tools and equipment in farming operations have increased the needs of farm people for instruction in all phases of farm mechanics. Teachers of vocational agriculture should receive adequate preparation for conducting such instructional programs as would meet these needs.

There is apparently a natural lag of time between current farming practice and college curriculum offerings in farm mechanics as well as other fields of agriculture. If the institutions that are responsible for the preparation of teachers of vocational agriculture are to improve their instructional programs they should have factual information as a basis for determining what the curriculum offerings should be.

+ This study was conducted in an attempt to answer two major questions relative to the preparation of teachers in farm mechanics as follows: (1) "What abilities are needed by Michigan teachers of vocational agriculture in teaching the farm-shop and farm-structures phases of their local programs?" (2) "How adequate has the college instruction been in developing the abilities that Michigan teachers need in their local programs?"

In an effort to answer these questions the following plans of investigation were set forth to be used as a guide:

1. To obtain samples of the several groups of personnel in Michigan representing valid opinion in regard to farm mechanics as a phase of vocational agriculture.

2. To establish the relative importance of the various farm-shop and farm-structures abilities needed by Michigan teachers of vocational agriculture.

3. To determine the adequacy of the preparation received by Michigan teachers in the various farm-shop and farm-structures abilities needed in teaching local programs.

4. To provide an accounting or digest of the nature and extent of the changes needed in the structional emphasis, in order to bring the importance and training statuses of each ability into closer harmony.

5. To provide a detailed guide for instructional planning for teacher preparation in farm mechanics by presenting an itemized statement of the 180 abilities, showing the (a) importance status, (b) adequacy-of-training status, and (c) extent-of-agreement status of each item.

6. To establish a basis for suggesting ways and means of further development of important abilities in the farm-mechanics course work taken by Michigan teachers of vocational agriculture.

7. To assess the nature and extent of supplementary experiences that improve the farm-structures and farm-shop abilities of Michigan teachers of vocational agriculture.

Three factors affect the need for this study in Michigan.

1. The importance of various farm-mechanics abilities does not remain fixed. The importance of farm-mechanics abilities as they relate to teaching vocational agriculture in Michigan changes with the needs for instruction in local programs. Variations in farming practice, changes in local farm-mechanics facilities, and other developments, affect the importance of the abilities needed by the teacher. It seems necessary, therefore, that periodic studies be conducted to determine the effect of such developments upon the importance of various abilities as a basis for curriculum planning.

2. The farm-mechanics curriculum for the preparation of teachers in Michigan is relatively new. The present farm-

mechanics curriculum for vocational agriculture teachers in Michigan has now been in effect several years. It appears desirable that an attempt be made at this time to evaluate the adequacy of the teacher preparation in terms of the importance of farm-mechanics abilities needed by teachers in the state.

3. There is continuing demand for teachers who are qualified to teach the farm-mechanics phases of vocational agriculture in Michigan. The number of local departments that offer farm-mechanics as a part of the regular program is increasing; this factor is likely to stimulate this demand still farther in the years ahead.

These three factors briefly summarize the needs for this study in Michigan; the overall needs for the study are further elaborated upon in the review of literature.

Basic Assumptions

This study recognizes and accepts the following assumptions:

1. Abilities represent one of the major products of the learning process.

2. The teachers' needs for abilities should represent one of the major objectives of the teacher-preparation courses in farm mechanics.

3. The development of abilities in the trainees taking the courses represent a realistic product of the adequacy of the teaching.

4. There is no ultimate authority on what should be included in the teacher-preparation curricula in farm mechanics in Michigan, but the most unbiased estimate would be represented by adequate samples of personnel associated with the various aspects and levels of vocational education in agriculture in the state.

5. The final selection of the content of farm-mechanics courses for the preparation of vocational agriculture teachers should be based upon the needs of Michigan teachers; these needs should be assessed in terms of the relative importance of the needs of farm people. A satisfactory way of stating teachers' needs would be in terms of abilities required in teaching the farm-mechanics phases of vocational agriculture at the local level.

6. A reasonably workable index of the past adequacy of the training can be established for use in determining the approximate extent of the change needed to produce closer agreement between the training emphasis and the importance index of each ability studied.

7. It would be desirable to have the instructional emphasis directed so as to produce the highest possible agreement between the importance and training indices of each ability in the farm mechanics courses.

8. Experienced teachers of vocational agriculture who have taken the farm-mechanics courses as preparation for teaching, have sound opinion relative to suggesting

ways and means of improving the development of abilities in college course work.

Scope and Limitations of the Study

Scope

This is a study in farm mechanics which includes the area of (1) farm shop, and (2) farm structures, and the major efforts have to do with determining what the course content should be, and with determining what the future training emphasis should be.

Four samples of respondents are included in the composite sample in each of the two areas. The composite samples were limited to the following groups of personnel:

(a) regular members of the staff of the agricultural engineering department of Michigan State University;

(b) regular members of the staff, and graduate assistants of the department of agricultural education of Michigan State University;

(c) supervising teachers of the agricultural education service in Michigan;

(d) state consultants of agricultural education in Michigan;

(e) regular teachers of vocational agriculture, certified to teach farm mechanics in Michigan and experienced in teaching farm mechanics;

(f) farmer-members of advisory councils serving local departments of vocational agriculture in Michigan where farm mechanics is taught as part of the program of vocational agriculture;

(g) this study involves only the technical agriculture aspects of teacher preparation.

<u>Limitations of the Study</u>

1. The data used in this study are subject to the usual error that is inherent in scores based on opinions. It has been noted in other parts of the study that percentages found throughout the study represent a relative measure only.

2. Scores representing adequacy of training include, and reflect, teachers' reactions to whatever each considered "adequacy" to be. Personal biases and/or errors of judgment may be reflected in the training scores.

3. Recommended changes in the instructional emphasis of particular abilities are subject to error because of changes that may have taken place in the farm-mechanics curriculum since the respondents received the training in those abilities.

4. Ability was defined on the check lists, however, there is no way of knowing whether all respondents accepted the definition as stated when checking the point scale.

5. A few respondents checked a majority of the abilities at the highest possible point, while a few others checked a majority of the items at the lowest possible point.

6. The scale on the checking instrument includes only three possible checks for each item, i.e., 0-5-10 points. Scores probably would have been more accurate if the scale had been constructed on a continuum.

7. Although the study includes a favorable percentage of the total advisory council members that were available in the State, the total number included is not large enough to be representative of the farmer population in the entire state.

8. Teachers' suggestions relative to ways and means of improving the development of abilities in college courses, may often refer to courses and methods that may have undergone alterations since the teachers were in school. Because of the unstructured nature of the section of the study on teachers' suggestions it was necessary to condense the statements into common items.

Definition of Terms

Farm mechanics. The term farm mechanics is used in this investigation to include all of the nontechnical phases of agricultural engineering as embodied in the five areas: (1) farm shop, (2) farm structures, (3) rural electrification, (4) farm power and machinery, and (5) soil and water management. Processing agricultural products is accepted in some sections of the country as the sixth area.

Farm structures. Farm structures has been used in this study to designate a subject area in farm mechanics which includes such units as (1) farm building construction, (2) concrete and masonry, (3) painting and glazing, etc. The area title is used interchangeably with "farm buildings and conveniences". For special reasons the seventy individual items in this area were expressed as "abilities". Teachers of vocational agriculture frequently refer to "jobs" within this area, viz., "constructing a brooder house".

Farm shop. Farm shop is used to designate a subject area in farm mechanics which includes such units as (1) tool fitting, (2) arc welding, (3) pipe fitting, etc. This study included nine such units and the 110 individual items were expressed as abilities. Teachers of vocational agriculture often use the expression shop "job" in reference to an activity such as "sharpening a jack plane".

Subarea or unit. These terms were used interchangeably to designate a block of related-subject abilities, or activities, within an area; a subdivision of an area into the naturally related phases. Example: Arc Welding is one "unit" or "subarea" of the area of farm shop.

Importance. Importance denotes a quality of being essential, weighty, or representing something of great moment. The term was used in this study as a relative measure of the value or worth of various farm-mechanics abilities to teachers of vocational agriculture in teaching the farm-mechanics phases

of local programs. The varying degrees of importance used in the checking scale were (1) essential, (2) moderate, (3) none. This scale applied to the units as well as to the individual abilities, and formed the basis of the statistical analysis.

Adequacy of training. Adequacy implies sufficiency for a purpose. The teachers who checked the forms in this study exercised the prerogative of making the decision as to whether the training received in a particular ability was sufficient, or adequate. Thus, the worth of a particular ability in teaching vocational agriculture classes would enter into the teachers' evaluation of the training; i.e., (1) a small amount of instructional emphasis might be adequate for developing a minor ability in the trainee, whereas, (2) a large amount of instructional emphasis might be inadequate for developing a major ability in the student. The varying degrees of adequacy of training used in the study were: (1) adequate, (2) moderate, and (3) none. The statistical analysis of the adequacy of training was based on this system of checking.

Ability. The quality in an agent which makes an action possible; suitable or sufficient power, faculty, or capacity (to do or of doing something).[1] This study employed the connotation of: "knowledge, understanding, and reasonable skill".

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[1] James A. H. Murray, A New English Dictionary on Historical Principles, Volume 1, Oxford: At the Clarendon Press, 1888, p. 20.

Psychologists apply two connotations in using the word, namely, (1) ability may refer to aptitude or proficiency, or (2) ability may denote both aptitude and proficiency. It seems, however, that ability is used, in the main, to denote aptitude plus learning.

The word ability has been used quite widely in describing objectives of vocational education,[1a] and it will be noted that the objectives listed by the subcommittee report[2] of the American Society of Agricultural Engineers and Agricultural Education Specialists, were stated in terms of abilities. Lancelot[3] devotes much discussion to the word ability. He refers to the abilities as "human factors.... representing knowledge in action".

The U. S. Office of Education publication, entitled "Organization and Administration",[4] spells out one of the main functions of teacher education as being the development of abilities needed by teachers of vocational agriculture.

1a Educational Objectives in Vocational Agriculture, (Vocational Division Monograph, No. 21, Washington, U. S. Office of Education, 1940).

2 "Agricultural Engineering Phases of Teacher Training for Vocational Agriculture", (A Report of the Subcommittee on Agricultural Teacher Training Committee on Curriculums, College Division, American Society of Agricultural Engineers in Collaboration with an Advisory Group of Agricultural Education Specialists, Submitted on June 22, 1944).

3 W. H. Lancelot, Permanent Learning, John Wiley and Sons, Inc., New York, Third Printing 1947; pp. 21, 22, 23.

4 Agricultural Education, Organization and Administration, (Part I, Vocational Bulletin, 13. Washington; U. S. Office of Education, Revised 1939); pp. 20-21.

Background of the Problem

The passage of the Morrill Land-Grant Act in 1862 creating a system of State Agricultural Colleges marks the beginning of a nation-wide system of agricultural education supported by federal funds. The growth and development of that movement was strengthened by the passage of the Smith-Lever Act in 1914, creating the extension service, and was climaxed by the passage of the Smith-Hughes Act in February 1917 creating a federally supported system of vocational education as a cooperative enterprise between the states, local communities, and federal government. The purpose of the Smith-Hughes Act was passed to foster the further growth and development of vocational education in several areas requiring skillful and technical training. The U. S. Office publication which sets forth administrative policies states that the purpose of the Smith-Hughes Act was:

> "to provide for cooperation with the states in the promotion of such education in agriculture and the trades and industries; to provide for cooperation with the states in the preparation of teachers of vocational subjects; and to appropriate money and regulate its expenditure." [5]

The passage of the Smith-Hughes and Smith-Lever Acts apparently came about as a result of public demand for education of a skilled and technical nature, not hitherto available in the public schools. Both of these laws were passed after long debate in congress, and after it became

[5] Ibid., p. 1.

apparent that the creation of the land grant system had not met the public needs for agricultural, trade, and industrial education. Although the land-grant colleges were meeting with success, the knowledge and skill available in those institutions had not been brought to the farmer level. The extension service and the vocational education organizations were established primarily, then, as the "channeling agencies" between the land-grant institutions and the people who need that type of education in various life occupations.

Agricultural education was one of the first branches of vocational education to make large strides in terms of growth and recognition on a national scale, and the early years of the movement were marked by the difficulty of securing teachers of vocational education in agriculture. During a greater part of the history of vocational education the shortage of teachers has been a common problem, and the job of preparing an adequate teacher supply has represented one of the major aspects of vocational education. The Smith-Hughes Act recognized that the success of vocational education would depend, ultimately, upon having an adequate supply of good teachers available and money was appropriated for that purpose.

Other acts passed since 1917, George-Dean, 1936, George-Barden, 1946, have strengthened and expanded the national system of vocational education, and in each instance provision has been made for teacher education. That the problem of providing an adequate supply of vocational teachers is considered to be of national concern is illustrated in a publication issued by the U. S. Office of Education which states:

> "The most important factor in the program of vocational education in agriculture is the local teacher of vocational agriculture. His training, therefore, is vital to the success of the program".[6]

That a similar concept is held by leaders at state levels is illustrated by the remarks of T. E. Browne,[7] (1942), Director of Teacher Education at North Carolina State College, in the Foreword of a bulletin that relates to teacher preparation in farm mechanics as follows:

> "This bulletin is designed for the use of teachers of vocational agriculture... Teachers of vocational agriculture in North Carolina are urged to place greater emphasis upon the teaching of farm shop work. North Carolina State College is stressing the teaching of farm shop to a greater degree than ever before in its teacher education program. Ample provisions have been made for an up-to-date farm shop...in the new quarters of the Teacher Education Division."[8]

These excerpts apparently typify a general feeling in the country in regard to the importance of proper training for teachers of vocational agriculture in farm mechanics. The author placed particular stress on the farm-shop phase of teacher education. Early in the history of vocational

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6 Ibid., p. 20.

7 J. K. Coggin and G. W. Giles, Farm Shop Activities and Equipment, Bulletin 5. University of North Carolina, Raleigh, N. C. 1942; p. 6.

8 Ibid.

education in agriculture there grew up a movement to provide additional preparation for teachers of farm shop, and as early as 1922 it was evident that state leaders in vocational education were interested in investigating ways and means of improving the farm mechanics training for teachers of vocational agriculture. That this concept was held is illustrated in the following quotation selected from a California bulletin. It states,

> "The California plan for vocational agricultural instruction in secondary schools organized under the federal and state vocational education acts, places special emphasis on the subject of farm mechanics. ....Not less than one-half of the total time set aside for applied work must be devoted to farm projects and not less than one-fourth to farm mechanics." [9]

The material covered by this bulletin represents an attempt to establish a basis for planning the course of study in farm mechanics in California schools. The undertaking was a joint project between the University at Berkeley, and the State Vocational Office. Professor L. M. Roehl of Cornell University collaborated in the state-wide study that was conducted. The term "farm mechanics" is used in the bulletin to designate all phases of agricultural engineering, and this early application of the expression later gained national acceptance. Some of the techniques used and the principles set forth in the California study are still valid in the field of farm mechanics.

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[9] Farm Mechanics for California Schools, University of California Division of Vocational Education, Berkeley, Cal., Bulletin 11. Nov. 1922, p. 3.

The increase in mechanized farming, and the introduction of inventions and new principles into agriculture, have intensified the demands for better trained teachers in farm mechanics. At the same time, these developments have increased the problems of the agricultural engineering departments in their teacher-preparation work.

The effects of the second world war further stimulated the need for teachers who were qualified to teach the farm-mechanics phases of vocational agriculture; the operation of the national defense and food production war training programs through the local departments of vocational agriculture further emphasized the farm-mechanics program. During that period the local farm-shop facilities were improved in many localities, and the public generally became aware of the value and need for adequate farm-mechanics programs in the local schools.

At the end of the war a large number of manufacturing concerns that had been engaged in the production of war goods turned their main efforts to the manufacture of farm equipment. The rapid expansion of mechanized farming since the close of the war has been the greatest in the history of the country, and this development has served to intensify the problems in preparation of teachers in the various phases of farm mechanics. As a climax to the growing problem of teacher training in this field the American Society of Agricultural Engineers, in collaboration with a group of Agricultural Education Specialists,[10] issued a publication outlining

[10] American Society of Agricultural Engineers, <u>op. cit.</u>

a proposed curricula in five areas of farm mechanics; each area was presented in the form of objectives and suggested abilities to be developed by teachers and prospective teachers of vocational agriculture.

As a result of that report, and other developments, a good many departments of agricultural engineering began to reorganize the farm-mechanics courses for the preparation of teachers of vocational agriculture and began to incorporate into the courses more of the type of instructional program advocated in the subcommittee report. A standing committee, relative to the teacher training question, had been organized into a permanent committee, and in 1953 a second report[11] was issued as a revision of certain phases of the first report. At this time (1953) a sixth area "processing farm-products" was suggested although it was not officially adopted as part of the report.

At the present time teacher-preparation programs in farm mechanics appear to be more similar in various sections of the country; an increasing number of agricultural engineering departments now follow the plan as advocated by the reports of the American Society of Agricultural Engineers and Agricultural Education Consultants. Several of the larger institutions, including Michigan State University, have established divisions of farm mechanics, and the teachers of vocational

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[11] Agricultural Engineering Phases of Teacher Training for Vocational Agriculture, Report II. Pre-Service and In-Service Training Programs, (The American Society of Agricultural Engineers, St. Joseph, Mich., 1953(

agriculture receive their farm-mechanics preparation in these divisions. Where the latter type of organization prevails a separate curriculum is provided for the prospective teachers of vocational agriculture, and this study is concerned with the areas of farm mechanics in a division of the type described.

The various terms that have been used in connection with the agricultural engineering phases of vocational agriculture have apparently been succeeded by the expression "farm mechanics".

Some departments of vocational agriculture in local schools in Michigan do not teach farm mechanics as a part of the regular program. This practice has been customary in schools that apparently lacked facilities for teaching the farm-mechanics phases of local programs. The number of departments in the state that teach farm mechanics as a part of the regular program is increasing, and there is a large demand for vocational agriculture teachers who are qualified to teach this phase of work. The curriculum of the agricultural education majors at Michigan State University includes courses in all five areas of farm mechanics. Graduates of this curriculum are qualified by training to teach farm mechanics at the present time. The present application of the problem has to do with the courses that are taken by these trainees.

CHAPTER II

REVIEW OF LITERATURE

Within the past two decades the concept of farm mechanics as a phase of vocational agriculture has undergone a great deal of change, with the result that the review of literature has been complicated by a problem in nomenclature. Some of the earlier studies refer to "farm shop" as including all of the agricultural-engineering phases of vocational agriculture, whereas "farm mechanics" is presently accepted as being the term that most adequately describes this phase of agriculture. The expression "farm mechanics" is used to denote all phases of agricultural engineering in these reviews, while "farm shop" is used to designate one area of farm mechanics.

The "Summaries of Studies in Agricultural Education", and various other publications, have reported a large number of investigations in farm mechanics since the passage of the Smith-Hughes Act. Only a limited number of these reports have pertained directly to the preparation of teachers. Quite a few of these studies, however, have been of such nature as to have direct implications for teacher preparation in farm mechanics. It has been assumed, over the years, that the farm-mechanics problems and needs of farm people constitute a valid basis for instructional planning, both at the high school and college levels. In the absence of direct research findings it has been necessary to accept the assumption as cited in this investigation and review of literature.

The review of literature is presented in three phases: (1) studies and/or writings in farm mechanics that have direct implications for teacher preparation; (2) studies and/or writings that relate to the method and techniques used in the present investigation, without regard to the subject area; (3) summary, or digest, of the reviews.

Literature in Farm Mechanics Relating Directly to the Preparation of Teachers

One of the earlier works that was directed toward establishing a basis for course planning in farm mechanics was reported by Struck[1] in 1920. The investigator's resource information was supplied by 400 Pennsylvania farmers who were fathers of vocational agriculture students. The units of concrete, wood work, and metal work were submitted to the respondents in the form of questionnaires. Struck's data show that a great majority of the repair work needed on Pennsylvania farms was being done by the farmers themselves; the author uses these findings to support his recommendation that the instructional programs in vocational agriculture should emphasize the type of work that farmers actually do, i.e., repair, rough construction, etc.

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[1] Theodore F. Struck, Farm Shop Work in Pennsylvania, (Rural Life Department, Special Bulletin No. 1, Pennsylvania State College, State College, Pennsylvania, 1920).

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Another early study in farm mechanics was conducted in California[2] (1922) for the purpose of establishing a basis for instructional planning in farm mechanics in that state. Again, the resource information was based upon actual conditions found on 273 California farms. The units of activity in this study show more detail than Struck's[3] study exhibited, and a scoring system was used to rate the importance of each item as a comparative basis for determining the nature of the course content. The only basis used in the California study was the actual situations found on farms, whereas the present investigation will use a cross-sectional approach (of valid opinion) to obtain the basic data for the analysis.

Another early study, of a similar nature, was reported by Armstrong[4] in Minnesota, involving a total of 560 farmers. The findings, as reported by that study, are in close agreement with the earlier research reported by Struck,[5] i.e., farmers indicated that they do most of the repair work that is done on farms.

The three studies cited in the foregoing discussion, came at the rate of one a year in widely separated areas, and produced such uniform findings, that they seemingly established

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[2] Farm Mechanics for California Schools, (Agricultural Education Series, No. 2, Division Bulletin, No. 11. Berkeley: University of California, 1922. 45 pp.

[3] Struck, op. cit.

[4] Fred E. Armstrong, Farm Repair and Construction Work, (Educational Monograph No. 4. Minneapolis: University of Minnesota, 1923). 38 pp.

[5] Struck, op. cit.

the validity of the use of community surveys as a means of determining what should be included in the farm-mechanics instruction; the records show that there is a notable increase in the use of this method in all phases of agricultural studies in the immediate years following.

Davies[6] reported on a study of 200 farmers in Colorado in 1923, the results of which were used to establish a basis for instructional planning. Davidson[7] reported on a study for the purpose of establishing a basis for course construction in farm mechanics in Kansas, based on the findings from the interview of 320 farmers. The latter represents the first large study in farm mechanics using a different method; previous studies had depended upon the use of questionnaires and/or check lists as the principal means of collecting the data. Kennedy's[8] study, reported a few years later, attempted to establish a basis for instructional planning by checking on the needs of Ohio farmers for farm-mechanics skills. The investigator collected the data through personal visits to the farms and by having vocational agriculture teachers and

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6 L. R. Davies, "Farm Shop Work in Vocational Education", (Unpublished Master's thesis, Colorado Agricultural College, Fort Collins, 1923). 94 pp.

7 Allen P. Davidson, "A Study of Farm Shop and Agricultural Engineering of Kansas Farms: Its Relation to Vocational Agriculture in Kansas High Schools," (Unpublished Master's thesis, Kansas State College of Agriculture, Manhattan, 1925). 40 pp.

8 Arthur C. Kennedy, "A Study of the Needs for Training in Farm Mechanics in Ohio," (Unpublished Master's thesis, Ohio State University, Columbus, 1927). 57 pp.

students help with the task. The findings, again, are stated in terms of rather large instructional, or subject, units with very little detail of individual skills or abilities stated.

A different technique was introduced by Sharp,[9] in 1928, in a farm-mechanics study which was conducted to establish a basis for instructional planning for high school classes. The investigator prepared comprehensive lists of farm-mechanics jobs and submitted these to farmers for checking the importance of each item in farming. A total of 500 farmers' opinions provided the basis for Sharp's[10] recommendations which stated, in effect, that the instruction should be confined to the jobs that are essential to the actual operation of the farm. After Sharp's investigation there was a trend toward greater detail in regard to the individual skills and abilities used in farm mechanics studies.

Walker,[11] a well-known author in agricultural education circles, reported on a farm-mechanics study in 1931, in Nebraska, which purposed to determine what the content of farm mechanics courses should be in Smith-Hughes high schools in that state.

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[9] Marley A. Sharp, "A Suggested Course of Study in Farm Mechanics for High Schools Based on the Opinions of Five Hundred Farmers," (Unpublished Master's thesis, Iowa State College, Ames, 1928). 37 pp.

[10] *Ibid*.

[11] Clyde Walker, "Determining the Content of Farm Mechanics Courses of Study for Smith-Hughes Agricultural Departments in High Schools", (Unpublished Master's thesis, the University of Nebraska, Lincoln, 1931). 80 pp.

The questionnaire method was used to collect the opinions of 200 farmers. Based upon the data supplied by farmers, Walker recommended reducing the emphasis on construction work and increasing the stress on operation, care, and repair of farm power and machinery.

Geiger's[12] study a year later followed the familiar method of determining what the "farm shop" needs were by making surveys of 100 farms. Data were collected by the use of questionnaires, and the findings are based upon the jobs that were actually being done by the farmers included in the study. The investigator concluded that farmers spend most of their time doing repair work, whereas, teachers devote most of the instructional emphasis to construction jobs. The recommendation was made to increase the instruction in the areas where farmers perform the greatest number of jobs.

In 1938 Wright's[13] investigation purporting to establish a basis for instructional planning at the high school level was reported, and this study has been widely quoted and referred to, in farm-mechanics circles since that time. The investigator introduced a technique which involved the checking of jobs, by farmers, in regard to the items which

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12 Albert J. Geiger, "A Study of Farm-Shop Work in Florida," (Unpublished Master's thesis, University of Florida, Gainesville, 1932). 106 pp.

13 Carlton E. Wright, "A Study of the Needs for Training in Farm Shop in High-School Departments of Vocational Agriculture in the State of Vermont," (Unpublished Master's thesis, Cornell University, Ithaca, New York, 1938). 120 pp.

"they desired to do better", in addition to the usual approach of listing the jobs that were actually being done on the farm. On the basis of the data supplied by 100 farmers, Wright suggested that the latter perform a greater number of jobs in the areas of carpentry, tool fitting, fencing, and machinery repair; whereas, forge work, soldering, furniture construction, and drawing represent areas of less activity. The data revealed also, according to Wright, that farmers would like to improve their abilities in making electrical repairs and installations, repairing machinery, carpentry, forge, and cold-metal work. The investigator concluded that (1) the status of the farmer is not a factor in determining the amount of mechanical work done; (2) type of shop work done on large farms is similar in nature and extent to that of medium-sized farms. The results, concluded the author, show that more mechanical work is done on farms that have farm shops.

Mulligan[14] introduced the technique of obtaining a cross-section of opinion relative to the farm-mechanics needs of farmers in forty-two New York counties. The investigator included the following respondents in the study: (1) 109 farmers, (2) 142 teachers of vocational agriculture, and (3) eighty-eight college students. The individuals in the three groups checked the relative importance of mechanical skills and "knowledge" in farming. The data, as reported by

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[14] Clarence W. Mulligan, "A Study of the Needs for Training in Farm Mechanics in New York State," (Unpublished Master's thesis, Cornell University, Ithaca, New York, 1941). 155 pp.

the investigator, show that the three groups were in general agreement in regard to the type of courses needed in vocational agriculture. The items included in the study are stated in terms of units rather than as individual skills and abilities, and the highest ranking of these are reported as follows: (1) tool fitting, (2) repairing machinery, (3) wood working, (4) saw filing, (5) rope splicing, (6) painting, etc. The investigator reported that one-half of the farmers included in the study had farm shops.

During the same year Proctor[15] reported on a study from Colorado that was designed to establish a basis for course construction in a particular community. Farmers and farm boys were asked to check 177 different mechanical jobs in regard to, (1) the frequency of the occurrence of the job in farming, and (2) whether the farmer performed it. The conclusion reached by the investigator was that (1) if fifty or more farms report the occurrence of a job it should be included in the course of study, (2) if fifty percent, or more, farmers report doing a particular job, it too, should be included in the course of study.

McCreight[16] attempted to establish a basis for course construction by determining the extent of the use of farm

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15 Phillip W. Proctor, "A Course in Farm Mechanics for Pittsfield, Illinois Community High School," (Unpublished Master's thesis, Colorado State College of Agriculture and Mechanics Arts, Fort Collins, 1941). 59 pp.

16 M. G. McCreight, "A Study of the Use of Acquired Farm Mechanics Abilities by Selected Vocational Agriculture Graduates of Nebraska Public High Schools," (Unpublished Master's thesis, University of Nebraska, Lincoln, 1951). pp.

mechanics abilities in farming. The investigator reported that, on the basis of responses from 182 farmers who took vocational agriculture in high school, the following areas of activity represent the most essential items in the actual operations of farmers: (1) painting, (2) tractor maintenance, (3) tool sharpening, (4) glazing, (5) farm machinery, (6) farm electricity, (7) rope, (8) carpentry, (9) forge, and (10) arc welding. Areas reported by the investigator as ranking below the average in importance are: (1) tractor repair, (2) plumbing and sanitation, (3) soldering and sheet metal, (4) heating and ventilation, (5) oxy-acetylene welding, (6) harness and leather, (7) concrete and masonry. The author concluded that high school students should be given opportunity to acquire the majority of the essential skills as a student in vocational agriculture in high school.

Cook and Byram[17] reported on a farm mechanics study in 1952, based on the reports of 676 farmers' activities in five areas of farm mechanics. Although not made as a direct attempt to establish a basis for designing college courses, this study has strong implications for teacher preparation in farm mechanics, and in this connection the investigators assumed that the preparation of teachers, in the main, should be in agreement with the activities that farmers do or want to learn.

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[17] G. C. Cook and H. M. Byram, "Mechanical Activities of Selected Farmers in Michigan," Research Project in Agricultural Education, Library of Michigan State College, East Lansing, 1952. 136 pp.

The data on which the analyses are based are classified under the following headings: (1) activities that farmers perform, (2) activities that farmers hire done, (3) activities that farmers would like to improve their ability in performing. The area of farm shop appeared to be the most important, while soil and water management appeared to be of least importance. The type of farming done did not affect the extent of activities performed.

The design of the Cook-Byram[18] study differs from the majority of farm mechanics investigations in two principal respects, _viz._, (1) the items (activities) included on the survey forms are presented with sufficient detail to provide a discriminative device for selecting the individual units of subject content in instructional planning, (2) the organization of the study was built around the five areas of instruction in farm mechanics.

The principal points of difference between the Cook-Byram study and the present investigation are, (1) the sources of information used to establish the basis for analyses, and (2) the former covers all five areas of instruction, whereas this study covers only two.

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18 _Ibid_.

Literature Relating to the Methods and Techniques of the Investigation

A non-thesis study was reported in 1952 by Hutson and Ekstrom.[19] This investigation was designed to: (1) establish a range of relative importance of various skills and understandings in several fields of technical agriculture included in vocational education; (2) to determine the adequacy of training received in the same list of items included in the importance phase of the study.

All of the teachers of vocational agriculture in Missouri were asked to check both importance and adequacy of training, and the reports were divided as follows: (1) teachers with five or more years of teaching experience, (2) less than five years experience. The analysis was made on the basis of these two groupings. Some significant differences were found between the responses of the two age groups.

According to the farm-mechanics division of the data, the investigators found that: (1) the items that ranked highest in importance related to tool fitting, concrete work, cutting rafters, servicing tractors, arc welding procedures, use of farm level, farm-machinery maintenance, and electricity and wiring; (2) some units of farm mechanics that ranked near the bottom of the importance scale were rope work,

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[19] Denver B. Hutson and G. F. Ekstrom, "Training Needs for Teachers of Vocational Agriculture",(Non-thesis study, University of Missouri, Columbia, Missouri, 1952). 16 pp.

glazing, laying out house plans, and the use of tile drain. (3) The teacher preparation appeared to be best in the units of tool sharpening, laying out terraces, soldering, aligning a cutter bar, arc welding, soil conservation practices, and farm machinery operation.

The final conclusions reached by the investigators were not available, however, it would appear that a sound basis for instructional planning in technical agriculture courses has thus been established in Missouri by investigation. The units of subject matter and/or activities used in the Hutson-Ekstrom[20] study are quite large in comparison to some of the more recent studies, i.e., "operation of farm machinery" covers a large number of skills, activities, etc. Some of the techniques used by these investigators are being employed more frequently in recent research.

Ryder[21] reported on a non-thesis study in 1953, using the technique of cross-sectional opinion relative to the needs of the farmers for skills in preventive maintenance in farm machinery and equipment. The method used was to validate a list of 85 skills by having agricultural engineers review these items. The list was then submitted to (1) farmers, (2) teachers of vocational agriculture, (3) agricultural education specialists, and (4) agricultural engineers, for checking on the importance of these items. Farmers, generally,

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20 Ibid.

21 Gordon Ryder, "Skills Needed by Farmers in Selected Areas of Farm Mechanics," Non-thesis study, Ohio State University, Columbus, Ohio, 1953. 24 pp.

rated skills lower than other groups, while agricultural engineers rated skills the highest. The investigator concluded that fifty of the items from the original list should be emphasized in farm mechanics instruction while four items should be omitted.

Ryder's[22] doctoral dissertation was an attempt to evaluate the effectiveness of the farm-mechanics aspects of teacher preparation of Ohio vocational agriculture teachers, based upon the teachers' appraisal of the adequacy of the farm-mechanics training received. The items on which teachers placed the adequacy rating was validated by obtaining 469 farmers' ratings of 375 problems relative to the importance of these items in farming.

Ryder's[23] study implies that the preparation of teachers should emphasize the problems that are reported by farmers as being the most important items.

The State Department of Education of Wyoming[24] recently published a special study to determine what is needed in the instructional programs in farm mechanics in Wyoming high schools. The investigators obtained the opinions of 613 fathers of boys enrolled in vocational agriculture classes in Wyoming. The reports were used as a basis for establishing

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[22] Gordon Ryder, "A Program of Teacher Evaluation in Farm Mechanics Education for Vocational Agriculture Teachers," (Unpublished doctoral dissertation, Ohio State University, Columbus, Ohio, 1954). pp.

[23] Ibid.

[24] Farm Mechanics Instruction That Farmers Want Their Boys to Have, Special Bulletin, The Wyoming State Department of Education, Vocational Division, Laramie, Wyoming, 1954). 10 pp.

the relative importance of seventy-two activities in farm mechanics. The activities represented types of work rather than specific jobs. The highest ratings were listed as: (1) electric welding and cutting, (2) tool grinding and sharpening, (3) acetylene welding and cutting, (4) repairing field machinery, (5) adjusting field machinery, (6) adjusting engines, etc. Items that ranked lowest in this study were: (1) ornamental concrete work, (2) setting wagon tires, (3) making finished articles such as tie racks, etc., (4) tooling leather, (5) rope work, etc. The publication concluded that local programs might be based upon the findings of this study since no differences were found to exist between the communities studied in regard to importance of various items included on the list.

In a book by Hamlin[25] the "cross-sectional" or "integrated" type of course in vocational agriculture is advocated by the author; in this type of organization "tight units" of subject matter, which may have been taught at a specific level in the four-year curriculum, would be abandoned (at least partially so) in favor of subject units as they are needed in solving farm problems. The author refers to this method as "scrambling".

Cook, Walker, and Snowden[26] advocate the use of: (1) community surveys, (2) planning courses around the

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[25] H. M. Hamlin, Agricultural Education in Community Schools, The Interstate Printers and Publishers, Danville, Ill., Second Printing, 1950. pp. 226-227.

[26] G. C. Cook, Clyde Walker, and O. L. Snowden, Practical Methods in Teaching Farm Mechanics, The Interstate Printers and Publishers, Danville, Ill., 1952. Chapter VII.

objectives of the instructional program, and (3) opinions and advice of advisory councils, farmers, shop teachers, extension agents, and other local people in deciding upon the content of farm mechanics instruction.

Hollenberg[27] issued a special pamphlet in 1954 through the U.S. Office of Education, advocating the "agricultural viewpoint" in organizing the instructional program in farm mechanics. By the use of this concept the author attempts to determine what the instructional needs in farm mechanics should be; Hollenberg advocates analyzing each agricultural enterprise which may be included in a total program of vocational agriculture. The farm-mechanics needs of a class in vocational agriculture would be derived through that type of analysis. The author suggests that the units in farm mechanics, in this sense, might be referred to as "dairy mechanics", "poultry mechanics", etc., in terms of the application that is made of the various skills and abilities. The author suggests types, and units, of instruction to be included in the five recognized areas of farm mechanics.

Rhoad's[28] doctoral dissertation represents an attempt to determine the training needs of vocational agriculture

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[27] A. H. Hollenberg, "Farm Mechanics Today and Tomorrow", (The U. S. Department of Health, Education and Welfare, Office of Education, Division of Vocational Education, Washington, D. C., 1954). 10 pp.

[28] C. E. 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," (Unpublished Doctoral dissertation, the Ohio State University, Columbus, Ohio, 1943). 342 pp.

teachers in several fields of technical agriculture by testing and measuring the adequacy of abilities possessed by a class of college seniors in agricultural education. One section of the study was devoted to farm mechanics. The method used by the investigator consisted of the following stages: (1) lists of abilities in several technical-subject areas were validated in terms of the needs of the items in teaching, by having the Ohio supervising teachers check the items as to importance; (2) the seniors in a class in agricultural education were tested, through the use of a battery of specially constructed tests, to determine the extent of the abilities possessed as compared to the extent of the abilities needed.

The findings reported by Rhoad[29] showed that the seniors in agricultural education possessed 54 percent of the abilities considered to be essential in teaching vocational agriculture. On the strength of the findings the author suggested various ways and means of strengthening the teacher-preparation programs in technical agriculture courses.

Chestnutt[30] advocated a plan for organizing the instruction, in all phases of vocational agriculture, around the farming programs of the students enrolled. On the basis suggested by the author, the instruction would vary from year to year, depending on the types of farms represented by the enrollment

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[29] Ibid.

[30] S. L. Chestnutt, "A Plan of Organizing Instruction", Agricultural Education Magazine, 18: 128-129, January 1946.

in different classes, and depending on the types of agricultural enterprises actually owned and operated by the students in the class.

Zindel[31] used the method of obtaining graduates' reactions to various phases of undergraduate curricula to determine some of the strengths and weaknesses of the college courses as reviewed by those men. The data used by the investigator consisted of reports from 254 graduates from various divisions of animal husbandry at Michigan State College. On the basis of the findings the investigator suggested several basic practices by which the instructional program in animal husbandry in Michigan could help to meet the needs of graduates of that department.

Another approach to the study of the animal husbandry curriculum, as this subject applies to the preparation of teachers of vocational agriculture, was reported by White[32] in 1951. The investigator reported that the amount of training received in animal husbandry is positively related to the abilities possessed and jobs taught in animal husbandry, and that the type of ability possessed is positively related to the type of jobs that are taught.

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31 Howard Zindel, "A Study of Graduate Reaction to the Animal Industries Curricula at Michigan State College", (Unpublished Doctoral dissertation, Michigan State College, East Lansing, Michigan, 1953). 175 pp.

32 Conrad P. White, "Factors Associated with Certain Abilities Possessed and Jobs Taught in Selected Livestock Enterprises by Teachers of Vocational Agriculture in Michigan", (Unpublished Doctor's thesis, Michigan State College, East Lansing, Michigan, 1953). 175 pp.

A regional study to determine the needs of teachers of vocational agriculture for technical skills was recently reported by Ahalt and Miller[33] in which the data represent the responses of 132 teachers of vocational agriculture randomly selected from the North Atlantic Region. The list of skills submitted to the respondents included 205 items covering the major areas in farm mechanics. The findings of the study indicated that the highest ranking areas were: (1) cold metal work, (2) wood work, (3) soldering and sheet metal, (4) painting, glazing and finishing, (5) tool fitting. The areas that ranked lowest in the study were: (1) arc welding, (2) concrete, (3) blacksmithing, (4) oxy-acetylene welding, and (5) fencing. It was stated that the investigators believed that the areas in welding ranked low because of the newness of these subject areas in the instructional programs.

Matela[34] used the technique of studying the curricula of twenty-two Land-Grant colleges to show the distribution of the relative importance of subject-matter areas in technical agriculture. On this basis, the investigator listed agricultural engineering as constituting 18.6 percent of training in the field of agriculture.

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[33] Arthur M. Ahalt and Harry T. Miller, "Technical Skills Needed in Farm Mechanics", The Agricultural Education Magazine, 27: 7, January, 1955.

[34] A. G. Matela, "Content of Curriculum for Teachers of Vocational Agriculture in Separate Land-Grant Colleges", (Unpublished Master's thesis, Iowa State College, Ames, Iowa, 1949). 124 pp.

Kirkland[35] attempted to determine the extent of the training needs of first year teachers of vocational agriculture in Tennessee by analyzing the difficulties encountered in the several fields of technical agriculture. The investigator concluded that 24 percent of the teachers experienced difficulty in performing the essential skills in teaching farm mechanics.

Summary of Literature Reviewed

The changing concept of farm mechanics as a phase of vocational agriculture, together with the increased application of engineering to agriculture, has stimulated research and writings in this field. A total of 135 studies in farm mechanics (and farm shop) have been reported in the "Summaries of Studies in Agricultural Education", while implications for farm mechanics instruction are evident in a large number of investigations listed under other headings in the "Summaries" as follows: (1) "teacher education", and (2) "course of study".

The Agricultural Education Magazine has published approximately forty-eight articles on various phases of farm mechanics.

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[35] J. B. Kirkland, "A Study of the Professional and Technical Difficulties Encountered by Teachers During Their First Year of Teaching Vocational Agriculture", (Unpublished Doctor's thesis, the Ohio State University, Columbus, Ohio, 1947). 464 pp.

In addition, special studies have been reported in connection with problems in farm mechanics, and some of these are not listed in the "Summaries of Studies". The latter statement applies also, to a number of thesis studies that were not reported in the summaries for various reasons.

The basic patterns established by Struck and others in the early studies in farm mechanics have prevailed, in the main, throughout the history of the farm-mechanics phase of vocational agriculture. In a large majority of the investigations reported, the analysis has been based upon farm mechanics operations and problems that are found on the farm, while another large group of studies has appealed to the opinions of farmers. A few investigations have appealed to the opinions of persons other than farmers; the latter technique has become more popular as a research technique within very recent years. The appeal to opinion, in the main, has sought responses in terms of (1) what is important to include in farm-mechanics programs, (2) how important are various items in farm mechanics, and (3) what activities would farmers like to improve their ability in performing.

Within recent years there has been a trend toward showing greater detail in the units included in farm mechanics studies; as an example, Struck's early study included only three major items while Ryder's recent study in Ohio included approximately 375 separate items. Along with the introduction of this trend there has been a definite movement to evaluate the college preparation of teachers in terms of instructional needs, and to suggest ways and means of improving the teachers' preparation on the basis of the findings of such studies.

The characteristics or traits that most nearly typify farm-mechanics research reports throughout the years (and currently) are: (1) that a wide variation in the needs for various skills, abilities, etc., exists from one section of the country to another; (2) neither is there any one method of organizing and teaching farm mechanics that is acceptable in every part of the country.

The fact that the findings of research in farm mechanics have varied so greatly is suggestive of close study of the methods and techniques used in order to make certain that future research will be valid in every respect.

The review of the literature has shown that there is a need for additional research in farm mechanics, particularly at the teacher preparation level. The apparent success of the several methods and techniques used in past studies indicates that the following adaptations that were used in the present study are sound research methods: (1) expert opinion was obtained from a cross-section of respondents representing various levels of vocational education in agriculture; (2) the organization of the report was built around the "area" division of farm mechanics; (3) adequate detail was used in stating the abilities needed within each area of the study; (4) the relative importance of the various abilities studied was established, within the limitations of the method used; and (5) an evaluation of the adequacy of teacher preparation was made, within the limitations of the method used.

CHAPTER III

THE INVESTIGATION

The purpose of this chapter is to trace the development of the investigation relative to the methods and techniques used. The following outline shows the order in which the material is covered: (1) the general plan of the study, (2) selection of respondents and descriptions of each group included in the study, (3) important events in the progress of the investigation.

The General Plan of the Investigation

Research Method Used

The normative method was used in this investigation to bring together the composite opinion and judgment of agricultural engineers, state leaders in teacher education, experienced teachers of vocational education in agriculture, and farmer members of advisory councils, relative to the needs of Michigan teachers for abilities in two areas of farm mechanics. The two subject areas included in the study were (1) farm shop and (2) farm structures. The geographic area included in the investigation is the State of Michigan.

The Technique to be Used in Collecting the Data

A purposive sample was used as the major source of information on which to base the investigation. This is a sampling technique in which the respondents are selected to meet the specific requirements of the study. The qualifications of respondents that are most important in this investigation relate to the adequacy of professional experience, educational backgrounds, and roles of leadership played by each. This study attempted to collect adequate samples of all relevant segments of the population connected with vocational education in agriculture in the state of Michigan.

Two major kind of information are needed: (1) responses regarding the importance of various farm-mechanics abilities in teaching vocational agriculture; (2) responses in regard to how well these abilities are being taught. In an attempt to provide a sound basis for studying these two aspects of the problem, the plan calls for a single presentation of data supplied by: (1) four groups of respondents presented as separate groups, (2) a composite of the four groups, (3) a separate group showing the adequacy of college training received by teachers. It was estimated that approximately 110 individuals would be included in the composite samples in both farm-shop and farm-structures areas of the study. The number of individuals actually reporting in the study, classified by groups, may be seen by referring to Table I.

The Medium of Measure for Responses

The plan of the investigation makes use of "teacher abilities" in terms of farm mechanics, as the medium or unit

TABLE I

GROUPS OF RESPONDENTS AND NUMBERS OF INDIVIDUALS INCLUDED IN THE INVESTIGATION

Respondents by Group	No. Included in Farm Shop	No. Included in Farm Structures
Agricultural Engineers	11	14
State Leaders in Teacher Education	12	14
Teachers of Vocational Agriculture	41*	39*
Farmer Members of Advisory Councils	42**	42**
TOTALS	106	109

*Teachers in Farm Shop are not the same individuals as those in Farm Structures.

**Farmers included in Farm Shop are the same individuals as those in Farm Structures.

of measurement. As a means of implementing the study, the term ability is used representing a worthwhile objective of education. Ability is defined in the problem section of the investigation. The selection of the term ability is based upon the acceptance of three assumptions, each of which affects and gives some direction to the overall plan of the investigation.

Three Assumptions Used in Designing the Investigation

The three basic assumptions that enter into the design of the study are as follows:

1. Objectives of the farm-mechanics courses should be set up in terms of abilities needed by teachers of vocational agriculture and should be taught somewhat in proportion to the teachers' requirements.

2. A valid method of assessing the extent and nature of abilities needed by teachers of vocational agriculture should include the composite opinion and judgment of all segments of personnel who are closely associated with vocational education in agriculture.

3. One way to evaluate the college instructional program for teachers of vocational agriculture would be in terms of how adequately each ability is being developed in comparison to its importance in teaching.

Using these basic assumptions somewhat as a guide, the design of the investigation was organized in the form which seemed to meet the needs and requirements of the study for specific types of data. The principal plans are discussed in the following paragraphs to give an overview of the study. Details relative to the scoring procedures and formulas used are presented in the topic "Tabulation of Data" and also in Chapters IV and V.

Information Needed

1. Evidence relative to the importance of and adequacy of training received in 180 farm-mechanics abilities needed in teaching vocational agriculture.

2. Suggestions and experiences of teachers of vocational agriculture relative to some ways and means of improving the development of farm-mechanics abilities in college course work.

The assessment of the relative importance of 180 farm-mechanics abilities, in two areas, was made by having an adequate sample of respondents check each item on a scale which was converted into numerical scores. Respondents included in the study were selected as representing valid opinion in regard to the relative importance of farm-mechanics abilities needed in teaching vocational agriculture.

The assessment of the adequacy of the training received by Michigan teachers of vocational agriculture in 180 farm-mechanics abilities was made by having experienced teachers check each item on a scale which was converted into numerical scores. The training data were obtained in a form similar to the importance scores, and both sets of scores were converted into like terms in order to make comparison between the two scales possible.

One section was devoted to an analysis of the data relating to teachers' suggestions for improving ability development in the farm-structures course work in college. Teachers' experiences were analyzed for possible effect on course planning.

A Plan for Organizing and Tabulating the Data

The purpose of this section of the study is to present the method used to organize and tabulate the scores in the two areas of farm mechanics. Provision was made to maintain group identity by tabulating the scores of the four groups separately. A basis for the analysis of the importance of each ability was provided by adding the four groups' scores to form a composite. The training scores were tabulated separately as a basis for the analysis of the adequacy of the training. The tabulation was done in two stages that are described in the following:

Stage-one tabulation. The first step in this stage required the preparation of ten large, ruled tables, each lined up alongside a series of the original lists of abilities in such a way that each respondent's checks could be tallied for the 110 abilities in farm shop, and 70 abilities in farm structures. The steps followed in the actual tabulation are listed in an abbreviated form in Figure 1. This figure is a

Fig. 1. Section chart of plan for tabulating scores of 110 Farm-Shop abilities by five groupings: First stage record.

Skeleton Form of Abilities to be Checked	Importance Data: Group 1 Ag. Engrs. 15*					Group 2 Teach. Ed. 14*	Group 3 Teachers 40*	Group 4 Farmers 40*	Training Data: Group 5 Teachers' Training 40*
	Name of Respondents								
	Doe	Hoe	Roe		Totals				
Area: Farm Shop									
Subarea:									
A. General Principles									
Ability to:									
1. Plan farm str.	5	0	10		125				
2. Plan school shop	10	5	5		135				
3. Plan for func.	0	5	0		130				
:									
:									
:									
:									
16.									
Subarea Total									
Grand Total: 9 Subareas 110 Abilities									

*Estimated Number

Steps Followed in Tabulating Data:

1. List names of respondents in vertical columns, as Doe, etc.
2. Check Doe's completed instrument to locate response to ability number 1.
   a. Enter 5 points since he checked "moderate" for the importance of the ability.
   b. Enter 10 points for ability number 2 since he checked "essential".
   c. Enter 0 points for ability number 3 since he checked "none" for importance.
3. In a similar manner check scores of 110 abilities on the list.
4. Follow same steps in entering scores of 14 other agricultural engineers.
5. Add (horizontally) the 15 scores for each ability and enter sums in column headed "totals".
6. Add (vertically) the 16 scores, in subarea A, for Doe, to obtain a personal total.
7. Add the ability scores listed in column, "total"; record sums of subarea "A". In a similar manner obtain totals of all subareas and convert into percentages.
8. Add 9 subarea totals to obtain a grand total score covering the farm shop area.
9. Convert grand total into a percentage score.
10. Check the vertical totals with horizontal totals; these must be equal.
11. Follow same steps to complete tabulation for groups 2, 3, 4, and 5.

"section-chart" reproduction of five tables shown in a parallel arrangement; a scale of approximately one inch equals ten inches has been used. Figure 1 is presented to give a general picture of the overall tabulation in regard to the number of respondents, and to illustrate how each one's responses were checked and tabulated. Little detail is possible in a table that is shown on such a small scale. The first-stage tabulation layout is too large to include in the study.

Figure 1 shows that the names of the respondents were listed at the top of the tables, while the abilities appear along the left-hand margin. The illustration used in the "section-chart" lists three names of the agricultural engineering group together with their responses to the importance of the first three abilities on the list. The scores that are recorded refer to "essential" (10 points), "moderate" (5 points), and "none" (0 points). These checks appear in the original instrument of each respondent. The training scale differs from the importance scale in one way only, viz., the first point on the checking scale is referred to as "adequate". The other two points on the training scale are the same as those applied in checking the importance. "Adequate" on the training list received 10 points.

The skeleton list of abilities was divided into subareas, the first of which contains 16 items. These subareas represent units of closely related abilities that require separate analysis; thus, B., Forge Work has a certain unity that is different from H., Rope Work.

The system of scoring that was used is outlined as follows: (1) each ability received a total score, by respondent groups, (2) each respondent received a score, by subareas, (3) each subarea of abilities received a numerical score and a percentage score, (4) a grand total score was derived, covering the entire list of abilities, and this score was converted into a percentage. Chapter IV cites an example of the conversion of numerical scores to percentages.

A special word of caution is needed in regard to the use of the percentage in the analysis of data. No absolute value is attached to any percentage score in these analyses. The percentages are used only as a relative measure of relationship between the groups of respondents and between the importance and training scores. The need for percentages arises from the fact that the respondent-groups vary in size, thus, the numerical scores as a comparative measure would not be usable. The percentage provides a measure that is in like terms.

Second-stage tabulation. This section explains the plan for organizing the data into six tables for each area of the study. Each of the six tables represents the scores of separate groups of respondents. Figure 2 is a section chart that illustrates some of the important steps in the second stage of tabulation. This phase of compilation consisted of three major steps as follows: (1) the first-stage tabulation

Fig. 2. Section chart of plan for tabulating scores of 70 Farm Structures abilities by groupings: Second stage record.

	Group 1 Ag. Engrs.					Group 2 Leaders in Teacher Ed.	Group 3 Teachers of Voc. Ag.	Group 4 Farmers	Group 5 Composite Importance	Group 6 Teachers' Training
	15					40	40		110	40
	1	2	3	4	5					
Area: Farm Structures Subarea: A. General Principles - Ability to:	No. Essent.	No. Moderate	No. None	Total Score	Rank					
1.Plan farm struct.	10	4	0	120	4					
2....	12	2	0	130	1					
3....	7	5	2	95	9					
4....	8	6	0	110	7.5					
5....	10	4	0	120	4					
6....	10	4	0	120	4					
7....	10	3	1	115	6					
8....	9	4	1	110	7.5					
9....	3	8	3	70	11					
10....	3	9	2	75	10					
11....	11	3	0	125	2					
Totals				1190						

Example: Agricultural Engineers' Farm-Structures Data, Subarea A. Source: Stage One Records

1. Check 15 Raw Scores of Ability No. 1 from stage on records as follows:
   a. Count no. of 10's and record in column 1 (no. essent.).
   b. Count no. of 5's and record in column 2, (no. mod.).
   c. Count no. o's and record in column 3, (no. none).
   d. Total of columns 1, 2, 3, must equal 14, the no. of respondents.
2. Repeat steps 1a, 1b, 1c, for each of 69 other abilities
3. Transfer 70 ability scores from stage-one tabulation, record in column 4, "total scores".
4. Transfer 7 subarea scores and grand-total score.
5. Repeat steps 1 through 4 for each group.
6. Composite: Add horizontally, scores in columns 1, of each groups 1, 2, 3, and 4. Enter the sum in column 1, the same as for ag. engrs.
7. Repeat process to obtain total no. "moderate", and "none".
8. Combine scores in columns 4, groups 1, 2, 3, and 4, and enter sum in composite.
9. Repeat step 9 for each ability on the list.
10. Add the 11 ability-scores (from step 10) in subarea "A" to get composite subarea score. Repeat process for remaining 6 subareas.
11. Convert composite subarea scores to percentage scores. Rank subareas and items.
12. Add the seven composite subarea scores to obtain the Grand Total Composite.

Total Subareas 7
Total Abilities 70

results, relative to the importance scores of four groups of respondents, were transferred to second-stage tables; (2) first-stage data, relative to the training scores of one group of respondents, were transferred to tables; (3) the importance data of four groups of respondents were combined to form a "composite of importance" scores. The same method applied in both areas of the study.

The abbreviated steps that were followed in doing the actual tabulation are listed on the cutaway section of the chart in Figure 2. A larger part of this tabulation consisted of counting and transferring the raw scores from stage-one to the second-stage tables. The summarizing process involved the compilation of scores obtained by adding the four groups' scores to form the composite. The central measure of comparison is the composite scores, and the total for each ability in this list is used to determine the overall importance of the individual items in each area of the study. The scores of the composite group are expressed in terms of total numerical and percentage scores representing 109 respondents.

The total scores of individual items in the training phase are used as a means of checking the degree of harmony between the determined importance and the adequacy of training received.

A Plan for Analyzing the Data

The analysis of the data is divided into two parts: (1) farm shop, (2) farm structures. Each of these two areas is analyzed with respect to five major aspects of the study; (a) the differences and/or similarities between groups of respondents, and as compared to the composite scores; (b) subarea relationships, as revealed by subarea scores of importance and training, by groups of respondents, and by the composite scores; (c) the item (ability) relationships regarding the importance and training revealed by the total ability scores within each subarea and within the whole area of the study; composite basis; and group basis; (d) teachers' suggestions for improving the development of abilities in college courses in the two areas; and (e) supplementary experiences of teachers that improved their ability to teach the farm-structures and/or farm-shop phases of vocational agriculture.

The major aspects of each type of analysis are included in the following:

Group differences and/or similarities compared. The group differences and/or similarities were studied by (1) comparing the grand-total scores of each respondent group to the composite, (2) by comparing the ranks of the subarea scores, (3) by comparing the ranks of items within subareas by the use of the statistic, rho, the rank method of correlation, (3) the overall item averages and percentages were compared.

Subarea relationships. This phase of the analysis dealt with the rank order of importance of the various subareas in each area of the study, using the composite as the central measure. The importance of different subareas of each area, from highest to lowest was determined and variations within the subareas were noted.

The subarea analysis included the training aspect of the study also.

Ability relationships (item analysis). The composite ability scores showed the overall importance from the highest to the lowest in numerical values. The same holds true for the training scores. This phase of the analysis went beyond subarea-division lines and studied the individual items, principally on the basis of numerical values.

A scatter diagram was used to plot the importance scores against the training, to show the extent of agreement or disagreement, between the two factors. A special analysis of the changes that may be needed in the training emphasis was made.

As a final step in this phase of the analysis the abilities were stated according to three statuses as revealed by the scatter diagram.

Teachers' suggestions and other training. The analysis of this section of the study was limited to items that had some common support and seemed to be of some importance in the investigation.

Supplementary experiences of teachers. The "extra-curricular" experiences of Michigan teachers were analyzed to determine whether there is a basis for taking such experiences into account in planning the college courses for these teachers.

Selection of Respondents

General Criteria

Practice varies from one state to another with reference to deciding upon the content and nature of farm-mechanics courses that are given for the preparation of teachers of vocational education in agriculture. In some instances instructional planning is handled by special committees representing the various groups of personnel who are responsible. Generally speaking, however, the planning and organizing of technical agriculture courses are functions that are carried out largely by the departments that teach the courses.

The selection of a desirable sample of respondents will go far toward obtaining valid answers to two parts of the major problem: (1) to determine what the relative importance of various farm-mechanics abilities is; (2) to determine how accurately the farm-mechanics courses are now directed toward fulfilling the needs of Michigan teachers.

This is not a new problem as can be inferred from the amount of investigation that has been devoted to it in recent years. Numerous methods and techniques have been employed in the studies of this nature. The majority of these investigations have depended on surveys and field studies for the information needed. A great deal of variation is noted in regard to the respondents that have been used as resource persons. The method used to select respondents in this study grows out of the question: "Who, individually or collectively, constitute the most valid opinion relative to what farm-mechanics abilities are needed by Michigan teachers of vocational agriculture?"

The question above points back to the problem itself where a more thorough treatment of it may be found, and it is merely noted here that the selection of the personnel of the required sample is a complicated problem, and the present attempt represents an effort to find out what the needs of teachers are by including representatives of all groups of personnel who have a large stake in the teacher's performance as it may relate to the college courses involved in this study. This premise leads to the establishment of some general criteria by which the major groups of respondents are selected namely, "respondent groups used in this investigation are selected on the basis of maintaining a major relationship in vocational education in agriculture."

Relationships that appear to be direct and of a major nature are represented by the following groups:

1. Teachers of vocational agriculture.
2. Teacher-education staff members in agricultural education.
3. Farmer members of advisory councils.
4. Members of the staffs of departments of technical agriculture having responsibility in the preparation of teachers.
5. State consultants in agricultural education.
6. Supervising teachers of vocational education in agriculture.

On the basis of this general criterion there are, perhaps, other groups that would qualify as participants in the study, however, the following additional criteria are submitted as being necessary in selecting the sample needed in this type of study:

1. The group is qualified to express valid opinion in this study on the basis of active participation and experience in a major function of vocational education in agriculture or in one that is closely related; or

2. the group is qualified by educational background either by having taken formal course work in farm shop and/or

farm structures, or by having had adequate compensatory practical experience in the area of participation; or

3. the group is recognized as filling a major place of leadership in vocational education in agriculture in either preparation, selection, placement, or supervision of teachers; or

4. the group is recognized as filling a major place of leadership in vocational education in agriculture in planning, organizing, and/or teaching local programs of vocational agriculture.

Based upon these criteria four groups of respondents are recognized as being qualified to participate and samples of each are included in the investigation. These groups are: (1) agricultural engineers, (2) state leaders in teacher education, (3) teachers of vocational agriculture, (4) farmer members of advisory councils. The composite opinion and judgment represented by the four groups included, is recognized as fulfilling the requirements for a valid frame of reference upon which to base the analysis, conclusions, and implications of the study. State consultants in agricultural education have been combined with members of the staff in agricultural education of Michigan State University, and supervising teachers, to form the group, "state leaders in teacher education".

By referring to Table I the overall situation regarding samples of respondents included in the two areas of farm mechanics may be seen. A total of 106 persons are included in the section of farm shop, while 109 are included in the farm structures area. Furthermore, this table shows that the number of persons in each respondent group varies for each of the two areas of the study except for the farmer group which includes the same individuals in both areas of the study.

Specific criteria applying to individuals within each group of respondents together with the description of the samples used in each major group follow.

<u>Selection of Agricultural Engineers</u>

Table I compares the number of agricultural engineers included in the study with all other groups of respondents, and Table II shows that there are fourteen, and eleven, respondents included in the farm structures and farm shop areas respectively. The respondents included in the study from the department of agricultural engineering at Michigan State University have been selected on the basis of meeting the conditions as set forth in the specific criteria as follows:

<u>Specific criteria</u>. (1) the respondent is a full-time member of the staff of the department of agricultural engineering at Michigan State University; (2) the respondent has taken adequate course work in the area of the study to be checked;

TABLE II

AGRICULTURAL ENGINEERS REPORTING IN FARM SHOP AND FARM STRUCTURES

NUMBER AND PERCENT INCLUDED, BY SUB-GROUP

Sub-Group	Total Number Staff*	Number Eligible to Participate	Respondents Included in Farm Shop			Respondents Included in Farm Structures		
			No. Solicited	No. Reporting	Percent Reporting	No. Solicited	No. Reporting	Percent Reporting
Teaching Staff	17	Shop - 7 Structures-10	7	7	100	10	10	100
Extension	6	5	4	3	75	4	3	75
Research	7	1	1	1	100	1	1	100
On Leave	2	0	0	0	0	0	0	0
Graduate Assistants	27	0	0	0	0	0	0	0
TOTAL	59	16	12	11	91.6	15	14	93.3

*Members of agricultural engineering department, Michigan State University

(3) the respondent has had adequate experience in (a) teaching farm mechanics or farm shop (area to be checked), or (b) research dealing with farm structures or farm shop (area to be checked); (4) personal factors are not taken into consideration. These include age of respondent, locale of past experience, degrees held, and the like. The fact that these men are members of the staff is accepted as evidence that the respondents are leaders in agricultural engineering.

The information in Table II lists 32 staff members as full-time employees at Michigan State University (two members of which are on leave of absence), while a group of graduate assistants brings the total to fifty-nine.

The use of only a part of the staff as resource persons is explained by the fact that some of these individuals do not qualify by the criteria. In several of the six academic and three all-college divisions the personnel are found to be specialists in particular fields, and some of these staff members have had little or no experience in the two areas of farm mechanics being investigated. Agricultural engineers included in the study are members of the regular staff at Michigan Staff University. These individuals have been selected for this particular study on the basis of training and experience in farm shop or farm structures, notwithstanding the fact that the entire staff would be qualified under the general criteria.

Table II shows that eleven agricultural engineers are reporting, of the twelve who are eligible to participate in the farm-shop area, while fourteen are reporting, of the fifteen eligible in the farm-structures area. Three respondents reporting in farm structures are not eligible to report in farm shop. Due to a wide range of experience and education in various states the graduate assistants are not included in the study although a number of them were interviewed in this connection.

From Table II it is seen that the overall percentage of returns is 91.6 for farm shop and is 93.3 for farm structures. Percentage is determined on the basis of the number actually reporting as compared to the number solicited.

Selection of State Leaders in Teacher Education

There are fourteen respondents in teacher education reporting in farm structures and twelve in farm shop as revealed by the data in Table III. Information in Table III shows the number of persons included in the four sub-groups together with numbers and percentages of these respondents reporting in both areas of the study.

The sixteen different individuals reporting in the two areas were selected on the basis of meeting the specific criteria listed below, in addition to being qualified as a group under the terms specified in the general criteria:

Specific criteria. (1) The respondent is a member of the staff in agricultural education of the department of vocational education at Michigan State University including

TABLE III

STATE LEADERS IN TEACHER EDUCATION REPORTING IN FARM SHOP AND FARM STRUCTURES

NUMBER AND PERCENT INCLUDED, BY SUB-GROUPS

Sub-Group	Total Number on Staff in Michigan	Number Eligible to Participate	Respondents Included in Farm Shop			Respondents Included in Farm Structures		
			No. Solicited	No. Reporting	Percent Reporting	No. Solicited	No. Reporting	Percent Reporting
Teacher Education, Regular Staff	6	6	5	4	80	6	5	83.3
Graduate Assistants	2	1	1	1	100	1	1	100
Supervising Teachers	8	6	3	2	66.6	3	3	100
State Consultants in Agricultural Education	7	7	5	5	100	5	5	100
TOTAL	23	20	14	12	85.7	15	14	93.3

the supervising teachers; or (2) the respondent is a state consultant in agricultural education of the Michigan State Department of Public Instruction; or (3) the respondent is qualified by having had institutional experience in teacher education; or (4) the respondent is qualified by having had experience as a consultant in vocational education in agriculture at the state level; or (5) the respondent has had at least two years of supervising-teacher experience; or (6) the respondent has taken college courses in farm shop and/or farm structures or has had practical experience of a nature deemed adequate to qualify him as a specialist in vocational education in agriculture.

The overall objective of obtaining a composite of valid opinion is well served by the use of state leaders in teacher education in this study. The close relationship existing between the state leaders in teacher education, and vocational agriculture teachers, places the former in a good position to know the needs of teachers for abilities in farm mechanics or any field of agriculture.

A study of Table III reveals that practically all of the individuals in the four sub-groups meet the conditions set forth in the specific criteria. Information in that table shows that only three persons of the total of twenty-three are not eligible for minor reasons.

A study of the data on which Table III is based shows that a satisfactory record of returns was obtained from the

the group as a whole. Supervising teachers were divided into two groups and three are counted as being "solicited" as respondents in each area of the study. The totals in Table III show that respondents are counted as reporting in farm shop at the rate of 85.7 percent of those solicited, while the reports used in the farm-structures phase turned out to be 93.3 percent.

Five members of the staff of the State vocational office are listed as being "solicited" and all five are listed in the group reporting. All respondents included in the teacher education group were interviewed and were given the instrument in person.

<u>Selection of Teachers of Vocational Agriculture</u>

Thirty-nine Michigan teachers of vocational agriculture are listed as respondents in the farm-structures phase of the investigation as compared to forty-one counted as reporting in the farm-shop area, according to Table IV. Practically all of these eighty individuals teach vocational agriculture in one of the 100 (more or less) departments in Michigan that are recognized by the state vocational office as meeting all requirements for providing farm mechanics as a regular part of the local program.

Figures in Table IV reveal that the 225 departments of vocational agriculture were listed by the State Department of Public Instruction, Lansing, Michigan, for the fiscal year

TABLE IV

TEACHERS OF VOCATIONAL AGRICULTURE REPORTING IN FARM SHOP AND FARM STRUCTURES, NUMBER AND PERCENT

Group	Total Number of Michigan Teachers	Total Number Eligible to Participate in this Study	Respondents Included in Farm Shop			Respondents Included in Farm Structures		
			No. Solicited	No. Reporting	Percent Reporting	No. Solicited	No. Reporting	Percent Reporting
Michigan Teachers of Vocational Agriculture	241	106	52	41	80	54	39	72.2

SUMMARY

A. Total Respondents Included

1.	Number reporting in Farm Shop	41
2.	Number reporting in Farm Structures	39
3.	Total in both areas	80
4.	Percent included in study	75.5

B. Total Respondents Included and Late Arrivals

1.	Total respondents included	80
2.	Total late arrivals	9
3.	Grand total received	89
4.	Percent received	84

1954-55. These Michigan departments employed 241 teachers of vocational agriculture as shown by the list for that year.

The conditions set forth by the general criteria seem to be met by the Michigan teachers as a group, however, when the individuals are studied it is apparent that only a part of the teacher group is eligible according to the criteria. It is to be noted that only those individuals whose teacher preparation in farm mechanics, and experience, qualify them to express valid opinion are accepted. The 80 teachers mentioned above are the group that are qualified by meeting the specific criteria:

Specific criteria. (1) The respondent is a regular teacher of vocational agriculture as evidenced by the appearance of his name on the list of Michigan teachers approved by the state department of public instruction, (2) the respondent is certified to teach farm mechanics by the state department of public instruction, (3) the respondent is now teaching farm mechanics, or has taught this subject in the past, (4) the respondent has taken the prescribed course work, or its equivalent at Michigan State College, in the area of the study to be checked.

The final selection of teacher respondents represented a rather complex problem beacuse of the variability that has existed in the farm-mechanics program in the state during the

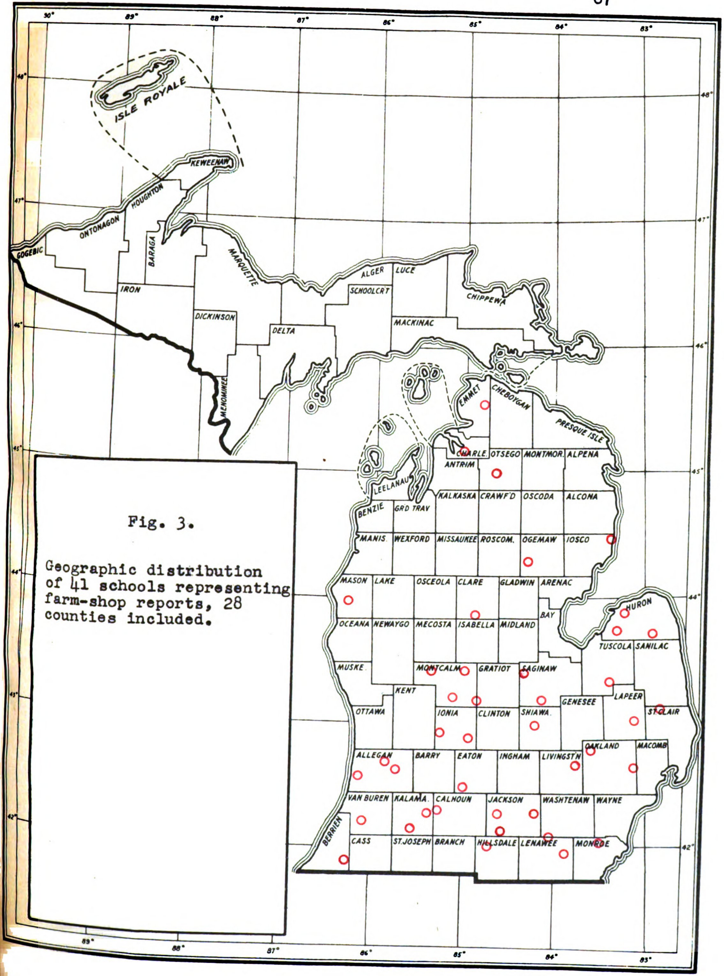

Fig. 3.

Geographic distribution of 41 schools representing farm-shop reports, 28 counties included.

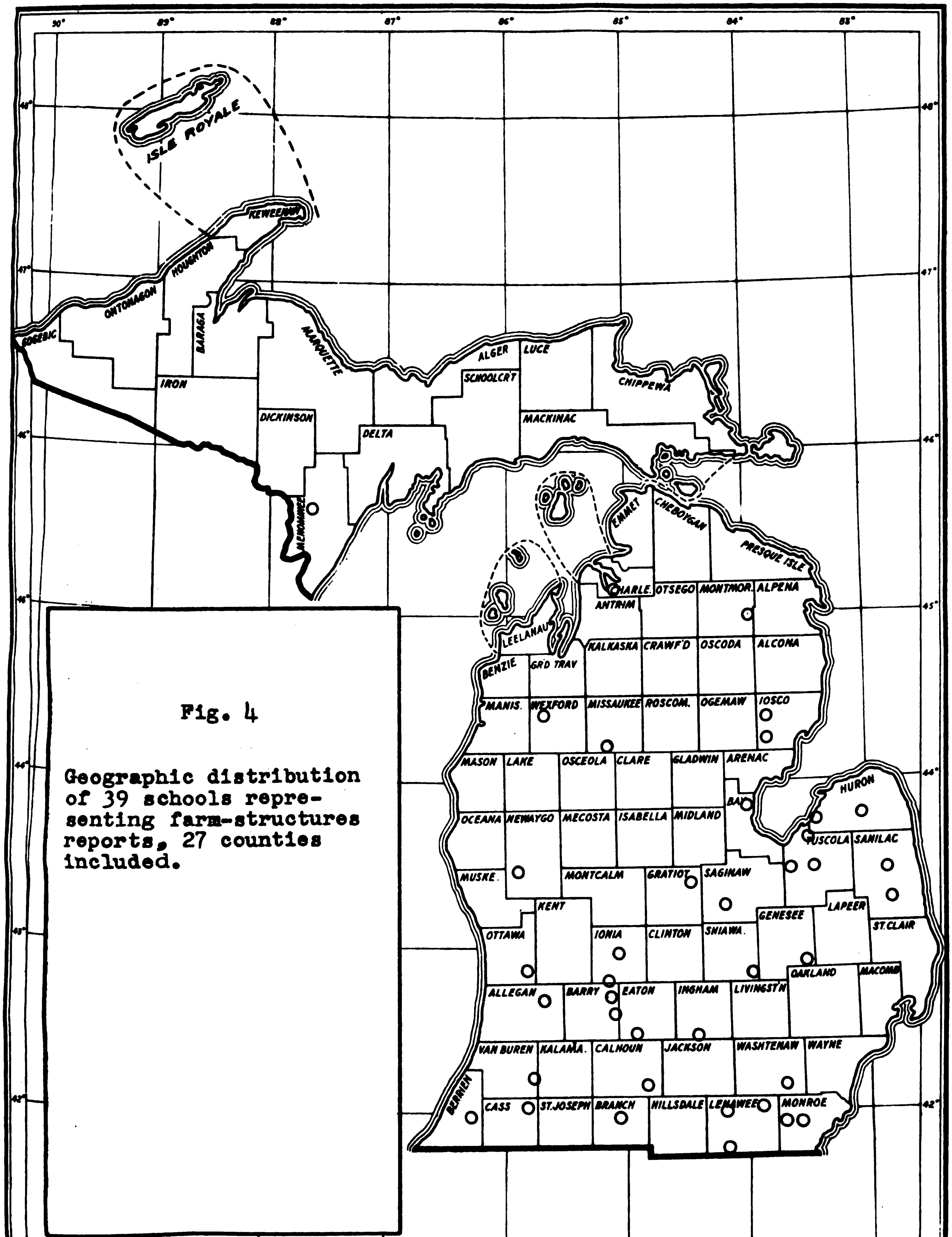

Fig. 4

Geographic distribution of 39 schools representing farm-structures reports, 27 counties included.

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past ten to fifteen years, and because of the changes that have occurred in teacher certification during that time. A study of the data on which Table IV is based shows that eighty teachers are included in the study, while the total number in Michigan is 241 for the 1954-1955 school year. This would appear to represent a low percent of participation until it is realized that only slightly more than 100 teachers are qualified, according to the general and specific criteria governing their selection. The two lists of teachers reporting, together with the schools they represent, have been appended to the study. See page 238 . The geographic distribution of the schools where they taught is plotted on two maps of the state of Michigan, Figures 3 and 4. Schools reporting in the farm shop area are distributed over twenty-eight counties while farm-structures reports represent twenty-seven counties. A study of these maps will show that a good coverage of the state was obtained in both areas of the study, with the exception of the upper peninsula, which is represented by only one school.

In addition to the eighty teachers' reports that are included in the study, nine other reports are classified as "late arrivals", making a total of 84 percent reporting in the overall returns. An original list of 120 teachers, as prospective respondents, was revised downward to 106 after omitting several teachers at their own request and for other reasons.

The only personal factor considered, aside from education as a specific point in the criteria, is the number of years of experience in teaching, and this is incidental to sample selection under the terms of the criteria. The length of teaching experience was examined as a preliminary analysis to ascertain whether any real differences existed between the group with the most experience, as compared to the group with the least experience. This preliminary analysis did not reveal any significant differences when the group was divided at the five-year line in both areas, consequently all teachers are presented as a single group in each of the two areas of the study. Teaching experience ranges from one to seventeen years.

Selection of Farmer Members of Advisory Councils

The data in Table I show that forty-two farmers are included in each of the two areas however these individuals are counted in both areas of the study. One of the general criteria requires that the respondents' group be closely associated with a major function of the process of vocational education in agriculture. The practice of having farmers serve in an advisory capacity in the planning of local programs is recognized as being one of the advanced techniques in vocational education in agriculture at the present time. Farmers who hold membership in these organizations serving local departments of vocational agriculture in Michigan are recognized as being qualified to express valid opinions in the study, by virtue of the close relationship that exists between the members of such organizations and the local departments. Membership in an advisory council is accepted as evidence that the respondent is filling a major place of leadership in agriculture. As a group, farmer members of advisory councils have been selected as respondents, with confidence, that they are qualified to participate. The following specific criteria apply in the final selection of individuals:

Specific criteria. (1) The respondent is a regular member of an advisory council serving a local department of vocational agriculture in Michigan; (2) farm mechanics is taught as a part of the regular program in the local department; (3) the member is classified as a "farmer" by the local teacher of vocational agriculture.

It should be noted that educational background, experience, age, farming status, and other personal factors, have not been considered in the selection of the farmers for this sample; personal factors are considered as being incidental in sampling.

The reports included in the study from nine advisory councils in Michigan represent an effort to obtain opinions from all active advisory councils in the state where farm mechanics is taught as a part of the regular program of vocational agriculture. A study of the information given in Table V shows that sixty-six respondents are included in this investigation; three of the members are women. The size of advisory councils included ranges from five to ten farmer-members, but this may not represent the total membership in any given council. The same table indicates that reports are included from 63.6 percent of the council members, and an additional three late arrivals brought the overall returns to 68.2 percent of the eligible membership.

The geographic locations of the schools served by the nine advisory councils are shown on the map of Michigan in Figure 5. A study of the distribution of the locations reveals that a total of seven counties, is represented, three councils being located in Lenawee County. Other geographic areas represented are as follows: (a) the lower western coastal region, one school; (b) the northern section of the lower peninsula, two schools; (c) the thumb area, two schools; (d) central lower Michigan, one school; and (e) southern Michigan, three schools.

One advisory council was fully qualified to participate except for the fact that the teacher of vocational agriculture is new in the position, and that school was omitted from the study at his request. Seventeen councils were considered for use in this investigation, however, the criterion regarding farm mechanics as a required part of the regular

TABLE V

FARMER MEMBERS OF ADVISORY COUNCILS REPORTING IN FARM STRUCTURES AND FARM SHOP, NUMBER AND PERCENT BY SCHOOLS*

Advisory Councils by School	No. of Farmer Members	No. Eligible and No. Solicited	No. Reporting	Percent Reporting
Gaylord**	5	5	2	40
Allegan	10	10	4	40
East Jordan	9	9	4	44.4
Mayville	7	7	7	100
Onstead	6	6	4	66.6
St. Charles	7	7	3	42.9
Tecumseh	5	5	4	80
Yale**	7	7	6	85.9
Britton**	10	10	8	80
TOTALS	66	66	42	63.6
OVER-ALL RETURNS	66	66	45	68.2

*Numbers and percentages refer to both farm shop and farm structures since the same individuals are counted in both areas of the study.

**One report from this council marked "late arrival", not counted in the "included reports", but cited as an over-all percentage of returns.

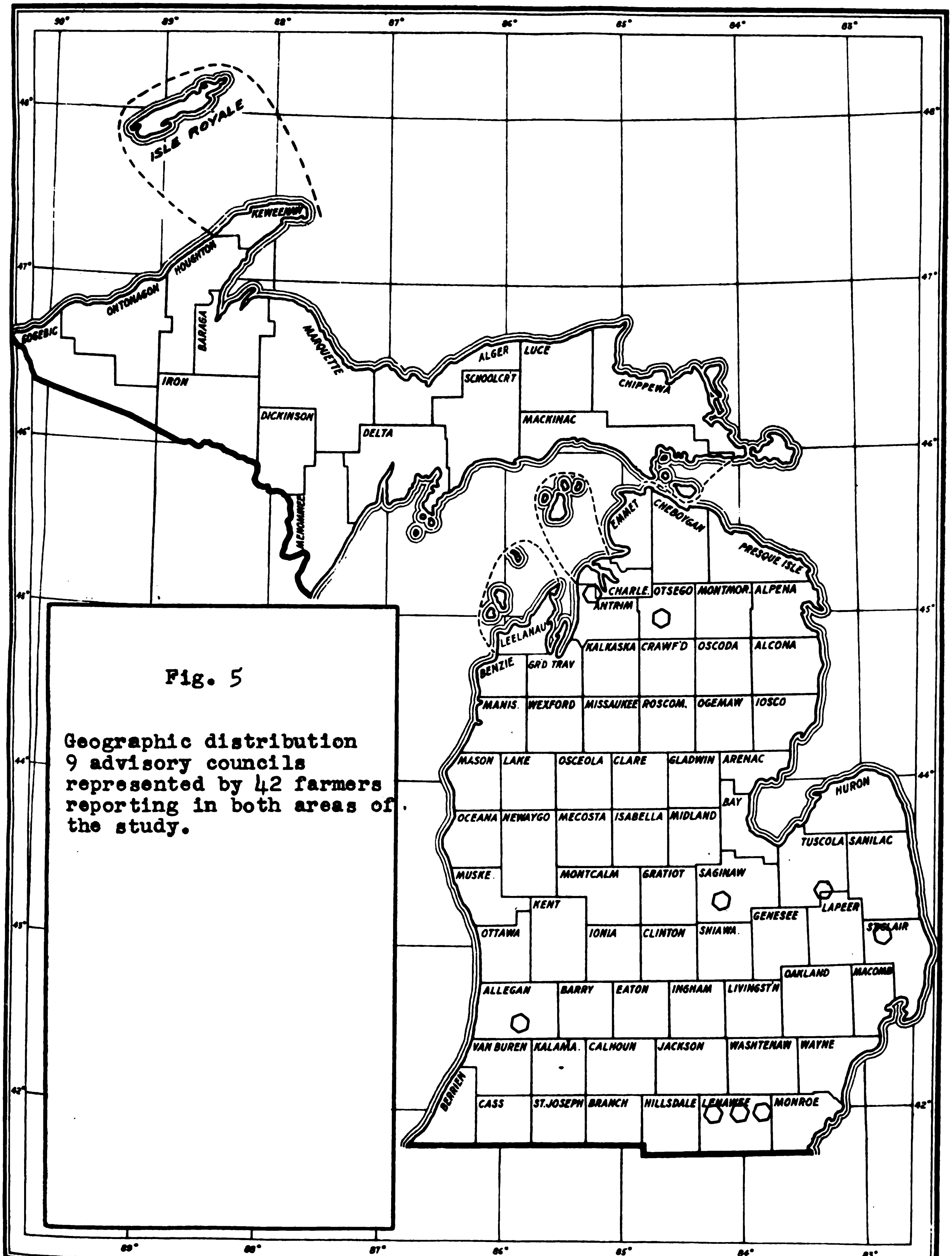

Fig. 5

Geographic distribution
9 advisory councils
represented by 42 farmers
reporting in both areas of
the study.

vocational agriculture program reduced the list to ten, and nine are represented in the final count.

Personal letters were sent to the respondents explaining the nature of the forms to be checked and asking that the completed instruments be returned by mail. The names of each council member included in this investigation are listed and appended to the thesis.

Important Events in the Progress of the Investigation

This section of the study gives an accounting of the development of the forms used to collect the data and relates some of the important events in the history of the study.

Preliminary Preparation and Construction of the Instrument

The original design of the study included all five areas of farm mechanics, (1) farm shop, (2) farm structures, (3) farm machinery and tractors, (4) rural electrification, (5) soil and water management. These are the areas recognized by the American Society of Agricultural Engineers[1] as constituting the field of farm mechanics. As the study developed it became apparent that the scope would have to be reduced to two areas. This decision was made when it became apparent

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[1] Agricultural Engineering Phases of Teacher Training for Vocational Agriculture, Report II, Pre-Service and In-Service Training Programs, (American Society of Agricultural Engineers, St. Joseph, Michigan, 1953).

that five areas included a greater scope than the investigation could cover successfully.

The instruments used for collecting the data were prepared in the form of abilities needed by teachers of vocational agriculture in teaching farm mechanics. Two lists of abilities were constructed, one covering the area of farm-shop, the other covering farm-structures. The initial preparation was made by searching the farm-shop and farm-structures literature. A major portion of the 1953 committee report,[2] relative to these two areas, was incorporated into the lists. Some study was made of the content of courses given at Michigan State College as teacher preparation in farm shop and farm structures, in preparing the lists, but the abilities selected were not confined to or limited by these factors in any way.

The design of the study did not include or require complete validation of the abilities submitted on the forms since the major efforts of the investigation itself were directed toward this end. The validation method consisted of having the lists checked by the specialists in the farm-shop and farm-structures divisions of agricultural engineering at Michigan State University. Several revisions of the lists were made with the assistance of these specialists. In order to make the selection of abilities more valid the lists were left "open-ended" in the final draft.

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[2] Ibid.

Members of the investigator's guidance committee made valuable suggestions relative to the further preparation of the instrument. In addition, state consultants in agricultural education, and members of staff in agricultural education of the department of vocational education of Michigan State University, made valuable suggestions in this regard.

During the period of September to December 1954, the forms were undergoing revision and reconstruction, and the final draft was completed in December of that year.

Forms Completed and Trial Run Held

A trial run, or test, was conducted to check the completed instrument at a meeting of the Michigan State College Staff in agricultural education, and supervising teachers, in December of 1954. At that time the purpose and method of the study was explained, and one-half of the supervising teachers were given farm-structures forms to check while the other half were given farm-shop forms to fill out. Arrangements were made to collect the completed instruments at a later date. Teachers agreed to make suggestions relative to needed revisions of the forms and to note these on the completed instruments.

The plan of the study was discussed, also, at a meeting of the state research committee and a generally favorable reaction was noted. A recommendation was made at that meeting to send the farm-structures forms to one-half of the

participating teachers of vocational agriculture in the state and to send the farm-shop phase of the study to the other half. This suggestion was accepted and incorporated into the plan. No further revision in the forms was made, and a schedule for mailing the instruments to the teacher group was set up to begin during the first week of January 1955.

Letters Mailed to Teachers

Personal letters to teachers of vocational agriculture were prepared, covering the nature and purpose of the study, and 120 of the instruments were placed in the mail on January 7, 1955.

The records of returns show that the first thirteen reports were received from teachers on January 11, 1955, and continued to arrive for several days. The last entry was recorded on February 18, 1955, making a total of eighty-nine reports received. However, nine of these reports arrived after tabulation was begun, and were not included in the data used. Several prospective respondents were dropped from the original list as being ineligible for various reasons.

Forms Sent to Farmer Members of Advisory Councils

In view of the smaller number of farmer members of advisory councils, it was decided that the two forms covering farm shop and farm structures should be sent as a "double form" covering both areas of the study, and to request farmers to check the forms in both areas.

According to plan, sixty-seven letters were mailed to farmer-members of advisory councils on January 18, 1955, and the first three reports were received on January 22, 1955. Daily entries are noted on the records at a rate of four to five reports a day for the period ending February 18, 1955, totaling forty-six returns. Four of this number are not included because of arriving too late for the tabulation.

State Leaders in Teacher Education and Agricultural Engineers Interviewed

Teacher education specialists and agricultural engineers were asked to check both areas of the study. The instruments, in this phase of the investigation, were delivered in person, and at the same time interviews were held with the men, explaining the nature and purpose of the study, and giving instructions for filling out the instrument. Arrangements were made to collect the completed forms in person; this was done according to plan in most cases. Altogether, about fifty interviews were conducted with professional and technical specialists, although several of these latter were not included in the study for various reasons.

The campaign that was conducted in connection with holding interviews, and collecting the completed forms, began in January 1955, and continued through February of that year. Response from all professional groups was excellent, as the records show.

Furthermore, it is believed that the large number of teachers and farmers reporting in the investigation represent those who have the greatest interest in farm mechanics, and the need for a purposive sample is served a good cause through the natural selectivity that thus, prevails.

Recording and Tabulating Raw Scores

Tabulation charts were prepared in accordance with the method that was described in the plan of the study, and the tabulation of raw scores began on February 15, 1955. The scores of the teacher group were recorded first. Tabulation continued for the next six weeks, including first and second-stage recording.

Summary

This chapter has traced the development of the investigation through the several phases of its history as follows:

Method

A. The general method used in the study was the normative survey.

B. The purposive sample was employed as a means of obtaining a composite of valid opinion from various individuals in the field of vocational education in agriculture.

C. The geographic area included in the investigation is the state of Michigan.

D. The responses sought are in answer to two aspects of a problem in farm-mechanics as follows:

1. What is the relative importance of various farm-shop and farm-structures abilities in teaching vocational agriculture?

2. How well are these abilities being taught in comparison to their importance?

E. The plan of the study required adequate samples of respondents from four groups: (1) agricultural engineers, (2) state leaders in teacher education, (3) teachers of vocational agriculture, and (4) farmer members of advisory councils.

F. The plan provided for collecting the information by means of a check list of abilities in each of two areas of farm mechanics (1) farm shop, (2) farm structures. The data were collected by mail and by personal interview.

1. Two checking scales were provided, one regarding importance of each ability, the other relating to the adequacy of training received.

2. A scoring system assigned numerical values to the responses as follows: 10-5-0 points.

G. The tabulation of the data was done in two stages including 215 respondents checking 180 abilities on a scale. The first-stage tabulation related to recording and summarizing the raw scores. The second-stage tabulation results provide the following:

1. Importance scores of 110 farm-shop abilities and seventy farm-structures abilities, summarized by respondent groups and by a composite.
2. Adequacy of training scores of 110 farm-shop and seventy farm-structures abilities summarized by a teachers group.
3. Subarea, or unit scores, of nine farm-shop units and seven farm-structures units.
4. A rank order of items within subareas, as well as a rank order of the subareas.
5. Grand total scores covering the entire area in both areas.
6. The plan also outlined the methods by which importance and training were analyzed showing (a) group analyses, (b) subarea or unit analyses, (c) item analyses, and (d) teacher suggestions and experiences.

Selection of Respondents

The four groups of respondents were selected in accordance with (1) general criteria, and (2) specific criteria for each group. A high percentage of representation was obtained from each of the four major groups included. Each sample was described relative to important characteristics. A total of 106 and 109 respondents are included in the farm-shop and farm-structures areas respectively.

The major events in the history of the study were traced in regard to delivery of survey forms, receipt of data, and the method used in tabulating the data, covering the period of September 1954 through March, 1955.

CHAPTER IV

PRESENTATION OF DATA RELATIVE TO THE FARM-SHOP AREA

The data relative to the farm-shop phase of the investigation are presented in this chapter including 106 individuals' scores covering 110 abilities on the list. The order of presentation follows the general plan of the study as outlined in Chapter III. Five types of analyses are presented as follows: (1) similarities and/or differences between the groups of respondents, (2) comparisons of relationships among the nine subareas of abilities with reference to both importance and adequacy of training, (3) an item-analysis, or study of relationships among the 110 abilities in the farm-shop area without regard to subarea divisions, (4) a study of teachers' suggestions for improving the development of farm-mechanics abilities in the college courses taken by these men in farm shop, (5) a study of teachers' supplementary experiences that improved their ability to teach the farm-shop phases of vocational agriculture.

Similarities and/or Differences of Respondents by Groups

The assessment of group relationships is presented in three sections as follows: (1) the overall picture of group harmony, as revealed by the grand totals of importance scores of the four groups of respondents compared to the composite scores, (2) the extent of agreement, as indicated by correlation coefficients computed by comparing the rank order of importance of the subarea scores, by groups of respondents, paired in all possible combinations, and paired with the composite ranks, (3) the extent of group differences, as indicated by the ranks of ability scores within the subareas, by groups of respondents, paired in all possible combinations; the correlation coefficients of all possible pairings of the four groups are presented, by subareas, as a means of showing specific points of disagreement, (4) each group is tested with the training scores, based on the ranks of the subareas.

The Extent of Group Agreement as Revealed by the Overall Importance Scores in Farm Shop

Table VI presents the grand-total importance scores covering the entire list of 110 abilities. The data show (1) the highest possible score, (2) the numerical scores recorded, (3) the percentages, (4) the difference when compared to the composite.

The composite scores of importance representing the responses of 106 individuals show that the percentage of importance, based on the highest possible score, is 78.7, which is computed by taking the total 91,785 points as a percent of 116,600, the latter representing the highest score that is possible, and it is referred to throughout the study as the highest possible score. Other total numerical scores are

TABLE VI

EXTENT OF AGREEMENT BETWEEN GROUPS OF RESPONDENTS AS REVEALED BY THE GRAND TOTAL SCORES OF IMPORTANCE AND TRAINING COVERING 100 FARM-SHOP ABILITIES

	Importance Data					Training Data
	11 Agri. Engrs.	12 Teach. Educ.	41 Teachers	42 Farmers	106 Composite	41 Teachers' Training
Total Score Recorded	9,090	11,240	36,250	35,085	91,785	24,865
Highest Possible Score	12,100	13,200	45,100	46,200	116,200	45,100
Total Percentage Score	75.1	84.7	80.4	75.9	78.7	53.1
Deviation from Composite	-3.6	+6.0	+1.7	-2.8	0	

NOTE: This table should be read as follows: The agricultural engineers' total score of 9,090 points is 75.1 percent of the highest possible score of 12,100, and this percentage represents a negative deviation of 3.6 compared to the composite score of 78.7 percent.

shown as percentages which have been derived on a similar basis. Percentages have been introducted into the analysis to provide a measure that is expressed in like terms. Some common measure seems necessary in order to make possible the direct comparison of group scores involving variable N's in the groups.

The extent of agreement between groups, in regard to the overall percentage scores, in the importance phase, is high when each group score is compared to the composite. The table shows that the largest difference is a positive 6.0 percentage points, when the teacher-education group is compared with the composite total. This difference is significant at the 5 percent level. The tendency to score the importance higher seems to be characteristic of the teacher-education group in both areas of the study. The extent of this difference seems to have little bearing on the analysis, although this question is studied further in later phases of the investigation.

The data in Table VI show that teachers are in closest agreement with the composite scores of importance, where a difference of only 1.7 percentage points is found. Agricultural engineers' total score represents the largest negative difference of 3.6 percentage points. It is noted that engineers tend to rate the importance slightly lower than other groups of most items throughout the investigation. Farmers' ratings, on the basis of a total, are slightly lower than the composite, as the negative 2.7 percentage points indicate. Appraisal of the overall agreement, based on the data presented, shows that there is general agreement between the groups.

Extent of Group Agreement as Revealed by Subarea Scores

Table VII shows the inter-correlation coefficients of the five groups when the rank order of importance is compared by subarea scores, and every possible paring between the five groups is used. These coefficients were computed from the ranks in Table IX by the use of the rank method of correlation. The formula for computing these values is: $\text{rho} = 1 - \frac{6\,(\sum d^2)}{N\,(N^2-1)}$.

The companion Tables VIII and IX show that the ranks are based on percentage scores; the percentages do not measure the absolute level of importance, or training, but represent the relative status of each. It is pointed out, however, that the overall scores of importance run considerably above the 50 percent level which would not normally be expected if the instrument had contained a better balance between the "essential" and "none" items on the check lists of abilities.

Generally, the group scoring-patterns as revealed in the study of the overall responses hold true also in the subarea ratings. As an example, leaders in teacher education scored tool care at 98.8 percentage points, the highest score recorded, while agricultural engineers scored forge work at 48.8, the lowest percentage recorded in the farm-shop phase of the study.

TABLE VII

EXTENT OF GROUP AGREEMENT INDICATED BY INTERCORRELATION COEFFICIENTS OF SCORES OF IMPORTANCE AND TRAINING BASED ON SUBAREA RANKS, BY GROUPS OF RESPONDENTS

Groups	Agri. Engrs.	Teach. Educ.	Teachers	Farmers	Composite	Teachers' Training
	I	II	III	IV	V	VI
I. Agri. Engrs.		.83**	.72*	.67*	.74*	.23
II. Teacher Educ.	.83**		.77*	.77*	.85**	-.12
III. Teachers	.72*	.77*		.87**	.97**	.08
IV. Farmers	.67*	.77*	.87**		.89**	-.12
V. Composite	.74*	.85**	.97**	.74*		-.02
VI. Teachers' Training	.23	-.12	.08	-.12	-.02	

*Significant at the 5 percent level
**Significant at the 1 percent level

TABLE VIII

PERCENTAGE SCORES OF IMPORTANCE AND TRAINING OF 9 SUBAREAS OF FARM-SHOP ABILITIES BY GROUPS OF RESPONDENTS

Subarea	Importance Expressed as Percentage Scores					Training Percentage
	Agri. Engrs.	Teacher Educ.	Teachers	Farmers	Composite	Teachers' Training
A. General Principles	86.6	92.4	86.0	89.9	88.2	53.4
B. Forge work	48.8	56.1	59.4	52.6	56.6	25.9
C. Cold Metal	86.9	90.3	82.1	75.5	80.8	63.1
D. Sheet Metal	76.1	78.1	80.6	64.7	73.3	68.2
E. Pipe Fitting	80.3	94.4	82.0	76.8	81.2	48.1
F. Arc Welding	74.7	88.0	86.1	85.1	84.7	58.5
G. Oxy-acetylene Welding	74.9	89.5	81.0	79.3	80.6	53.4
H. Rope Work	64.7	80.8	76.0	67.0	71.8	65.0
I. Tool Care	87.7	98.8	89.2	86.7	89.1	59.4

TABLE IX

RANKS OF IMPORTANCE AND TRAINING BASED ON SUBAREA PERCENTAGE SCORES AS CHECKED BY 6 GROUPS OF RESPONDENTS IN FARM SHOP

Subarea	Rank of Importance					Rank of Training
	Agri. Engrs.	Teacher Educ.	Teachers	Farmers	Composite	
A. General Principles	3	3	3	1	2	6
B. Forge Work	9	9	9	9	9	9
C. Cold Metal	2	4	4	6	5	3
D. Sheet Metal	5	8	7	8	7	1
E. Pipe Fitting	4	2	5	5	4	8
F. Arc Welding	7	6	2	3	3	5
G. Oxy-acetylene Welding	6	5	6	4	6	7
H. Rope Work	8	7	8	7	8	2
I. Tool Care	1	1	1	2	1	4

With reference to the intercorrelation coefficients, as shown in Table VII the statistic, rho, is used as a test of group independence. This statistical method is independent of the nature of distribution of the scores which makes it a valuable technique in dealing with the asymmetrical distributions found in almost all groups' scores in this study. The importance distributions show large negative skewness, while the training distributions are positively skewed.

The correlation coefficients (rho) have been calculated by taking each vertical series of rank orders of subarea scores (Table IX) and applying the rho formula in every possible pairing between groups.

From a study of the rho's shown, it is apparent that there is a high positive relationship between all major groups with respect to the order in which they rank the subarea scores of importance. Of the twenty coefficients listed, Table VII shows that nine are statistically significant at the one percent level, while the other eleven are significant at the five percent level.

This high extent of agreement is suggestive of abnormal factors of some kind. However, a closer examination of the data, on which these coefficients are based, reveals why the latter tend to be so high, i.e., there are several points of perfect, or near perfect agreement with respect to ranks between all groups as follows: (1) Table IX shows that forge work represents perfect agreement since all groups ranked that unit ninth, or last, while (2) tool care is rated in first place by three of the four groups, (3) general principles, in second place in the composite, is ranked third by three out of four groups.

The evidence, as revealed by these data, show a high positive relationship between all groups of respondents, with respect to the order in which they ranked the importance of subareas in farm-shop, and the hypothesis of independence as between groups is rejected on this basis. Note: Composite has been considered as the fifth group.

<u>Inter-Group Relationships as Revealed by the Variability of Scores Within Each Subarea</u>

The preceding topic dealt with respondent-similarities and differences based on the overall scores, and the hypothesis of independence was tested in regard to how the group ranked the nine subareas of abilities in the order of magnitude of percentage scores. The present phase of the analysis stresses group harmony in regard to the variability of individual-item scores within each subarea.

Table X shows the intergroup correlation coefficients that are used to test the hypothesis of independence. The table has been constructed in such a way that each group is paired in every possible combination, and the data are presented to show coefficients of each pair -- a total of fifty-four values.

TABLE X

INTER-GROUP CORRELATIONS COEFFICIENTS BY SUBAREAS, BASED ON THE INDIVIDUAL

RANKS OF ABILITY SCORES OF IMPORTANCE IN FARM SHOP

AREA Farm Shop	Ag. Engrs. and Farmers	Ag. Engrs. and Teachers	Ag. Engrs. and Teach. Ed.	Teacher Education and Farmers	Teacher Education and Teachers	Teachers and Farmers
A. General Principles	.63**	.60*	.43	.35	.35	.44
B. Forge Work	.02	.39	.60	.60	.70*	.92**
C. Cold Metal	.54	.48	.76*	.45	.40	-.16
D. Sheet Metal	.70*	.72**	.79**	.72**	.73**	.73**
E. Pipe Fitting	.42	.37	.53	.35	.77*	.66*
F. Arc Welding	.83**	.91**	.95**	.88**	.87**	.74**
G. Oxy-acetylene Welding	.95**	.87**	.82**	.80**	.86**	.81**
H. Rope Work	-.28	.44	.20	.01	.29	-.18
I. Tool Care	.60	.79*	.76*	.63	.66	.55

* 5 percent level
** 1 percent level

Several kind of variability tests turned out to be invalid, when it was determined that the distributions of the responses were asymmetrical and the rank method of correlation seems to be the most feasible means of appraising the inter-group, item-score variability, as the case appeared to be in testing group differences in the subarea study.

The method used to calculate rho of individual item-ranks is identical with that used in connection with the subarea-score tests, with one exception, namely, that each ability has been ranked in this test, whereas the subarea test employed the rank of each subarea considered as a whole.

The procedure followed in applying the rank correlation formula was discussed briefly in the preceding section. In the present application the individual item scores are used instead of the subarea scores.

Garrett's[1] test for significance of an N of sixteen shows that the engineers'-farmers' coefficient is significant at the one percent level and the hypothesis of independence is rejected. In a similar manner, the fifty-four different coefficients have been computed, and asterisks are used to indicate the levels of significance or the absence of it.

A study of the data on which Table X is based reveals some variability between groups that was not discernible in the previous section of the investigation. In general, however, the table of coefficients shows a rather high degree of positive relationship, one-half of the rho's meeting the test

[1] H. E. Garrett, Statistics in Psychology and Education, Longmans, Green, and Company, New York, 1953, p. 200.

of significance at the 5 and one percent levels, while the other half indicates positive relationship in most instances, and in several cases the rho's are near the 5 percent level.

Group variability is greatest, as indicated by the data, in the subareas of (1) rope work, (2) cold metal, and (3) forge work. The only negative relationships in the fifty-four pairings are found in the subareas of rope work and cold metal. It is interesting to note that the "overall" analysis showed there was general agreement between the groups with respect to rope and sheet metal - ranks seven and eight - as units, yet the respondents are not in agreement in regard to the importance of the various abilities within these two subareas.

There are some instances of significant agreement within the two subareas of forge work and cold metal work namely, (1) agricultural engineers paired with teacher education specialists show a rho of .76 in cold metal, (2) agricultural educators paired with agricultural engineers yield a rho of .76 in cold metal, and when paired with teachers yield a rho of .70, (3) teachers' relationships with other groups in this low area of agreement, also contain two statistically significant values, (a) when paired with leaders in teacher education, rho .70, and with farmers, rho .92. Farmers' only significant positive relationship appears from the pairing with teachers, rho .92.

The few negative relationships are low in this respect, and these represent the pairs of (1) agricultural engineers-farmers, in rope work, (2) teachers-farmers in rope work, (3) teachers-farmers in cold metal work. The largest negative coefficient is minus .28 which is below the level of significance on the negative scale.

Other coefficients, representing various combinations of groupings in the three subareas of lowest agreement, show positive relationships in every instance, some of which are near the level of statistical significance.

Another general classification of group differences is the "average agreement" area. The latter group includes: (1) tool care, (2) general principles, (3) pipe fitting. The numbers of coefficients that meet the test of significance in these three units are about equal to those that do not.

Based on the number of coefficients meeting the test of significance, the groups that show the highest positive relationships are listed in the following order, when paired with all other groups.

1. Teachers, 15 coefficients significant
2. Agricultural engineers, 14 coefficients significant
3. Teacher education, 13 coefficients significant
4. Farmers, 12 coefficients significant
5. Total significant coefficients, 27
6. Total array of rho's, 54
7. Percent of significant coefficients, 50.

The data presented in this section of the study show that the (1) general agreement between groups is high except in the area of rope work; (2) group agreement is positive, but not high, between all pairings in the subareas of forge work and cold metal, except for one instance, which is a low-negative relationship; (3) three subareas represent complete group agreement, as measured by rho, at the 5, and one percent levels; (4) three subareas are considered "average" as measures of group agreement, although the positive relationships outweigh the neutral and negative measures by a wide margin; (5) teachers' pairings with other groups tended to show slightly higher degrees of positive relationships than any other group, agricultural engineers ranked second in this respect, farmers tended to show the least extent of agreement in the overall picture; the teacher education group ranked third with respect to total group tendency toward high positive relationship.

Based on the evidence, as shown by rho, in regard to variability of item scores within each of the nine subareas of abilities in the farm shop phase of the investigation, the positive relationships between groups outweigh the negative, and the hypothesis of independence is rejected.

Subarea, or Unit, Analysis

In this phase of the study the data that relate to the importance and training scores of the nine subareas in farm shop are presented without regard to respondent groups, and the composite sample is taken to represent the importance aspect. The basic data that are used in this phase of the study are included in Tables VIII and IX which appear in the preceding section.

Overall Importance of Nine Subareas Included in the Farm-Shop Area

The study of group relationships showed that there were two or three subarea relations that can be presented with a good deal of confidence as a result of almost complete unanimity found in the overall scoring which is reviewed as follows: (1) the subarea tool care, is ranked at the top of the list based on information in Tables VII and IX. All groups scored this subarea first, with the exception of farmers who ranked it second. The second subarea, in order of importance is: (2) general principles, which received a majority of the second place ranks; and (3) arc welding was rated in third place with a relatively high composite score also.

On the basis of the overall percentage scores the nine subareas in farm shop are listed in the decending order; both importance and training scores are shown in the following lists:

Importance		Training	
Subarea	Percent	Subarea	Percent
1. Tool care	89.1	1. Sheet metal	68.2
2. General principles	88.2	2. Rope work	65.0
3. Arc welding	84.7	3. Cold metal work	63.1
4. Pipe fitting	81.2	4. Tool care	59.4
5. Cold metal	80.8	5. Arc welding	58.5
6. Oxy-acetylene welding	80.6	6. General principles	53.43
7. Sheet metal	73.3	7. Oxy-acetylene welding	53.37
8. Rope work	71.8	8. Pipe fitting	48.1
9. Forge work	56.6	9. Forge work	25.9

All respondents placed forge work at the bottom of the list in importance, and in addition, there is close agreement on the low importance of rope work and sheet metal. General principles, tool care, and the two units in welding appear to be of greatest importance to the teacher of vocational agriculture, if the data is accepted as being valid. Some variations of importance of individual abilities within subareas exist; an analysis is presented in a later section for the purpose of assessing individual-item variability.

Relationships Between the Training Scores and the Importance Scores of Subareas

The rank order of the subarea training scores, as viewed in Tables VIII and IX, is not in agreement when compared to the ranks of the subareas based on the composite importance scores.

A study of the data on which these tables are based reveals that there are several points of wide variability, the most obvious of which is tool care; while the importance of this item is rank one, the training is ranked in fourth place. Again, block general principles, is ranked second in importance, yet the training is ranked only sixth, which represents a total of four ranks out of order. Another discrepancy is noted in the rank of the unit, pipe fitting, which occupies the fourth position, in terms of importance, but is ranked only eighth in the training. This is another instance of four-ranks of discrepancy.

Rope work, which is ranked near the bottom in importance, (eighth) received rank two in the training scores. This comparison represents a situation that is six ranks out of harmony with the importance scores in the opposite sense, that is, the training rank is higher than the importance rank. Another equally important fact, revealed by the data in Table IX, is the rank of sheet metal, which is found to occupy the seventh position in importance, but is rated in first place in the training. This represents another six-rank discrepancy in which the training is extremely high in comparison to the importance.

The only area that is in complete harmony, in regard to the importance and training ranks, is forge work, which is rated at the bottom of the list in both respects.

Table VII, showing the intercorrelation coefficients between various pairings, include the rho values of the training ranks when paired with the five groups of importance ranks, taken by series of subareas. These coefficients bear out the general impression, given in the preceding discussion, to the effect that little positive relationship exists between the ranks of the training scores and ranks of importance scores when considered as subareas. The data in this table show that the highest coefficient is .23, a rho score that is obtained when agricultural engineers' rank order is paired with the training ranks. Low negative relationships are found to exist between three of the pairs with respect to the training and importance ranks of subareas, while the other pair has a rho of .08.

It is apparent that there is a large difference between the ranks of the subarea scores in training and importance. The hypothesis of independence in this instance must be accepted and will receive further discussion in other sections of the study.

Item Analysis

Previous treatment of the data have related to respondent-group agreement and subarea, or unit, relationships. It is the task of this section to examine the ability relationships as individual items. The training and importance aspects of each item are presented.

The item analysis is presented in four parts as follows: (1) an overall comparison of the individual training scores with the individual importance scores, (2) the relationships of item distribution as revealed by a scatter diagram, (3) an itemized statement showing each ability with respect to the level of importance, level of training, and extent of agreement, and (4) a digest of ability characteristics showing the need for changes in the training emphasis of each item.

Comparison of the Training and Importance of 110 Farm-Shop Ability Scores Based on the Total Distribution and Subarea Arrangement

Table XI includes the data relative to several characteristics of the two score-distributions that seem to have an important bearing on the study.

TABLE XI

CHARACTERISTICS OF THE DISTRIBUTIONS OF TRAINING AND IMPORTANCE SCORES OF 110 ABILITIES IN FARM SHOP

Characteristic or Measure	Importance Distribution or X-Variable	Training Distribution or Y-Variable
Range in Score Value	420 - 1030	30 - 370
Mean of Distribution	834.9	230
Sigma of Distribution	125.75	85.95
r equals .604		
N equals 110		
1 percent level of significance .23		

The relative importance scores in the importance distribution are quite high, creating a negative skewness in the distribution. The mean of the importance distribution is 834.9 points, whereas, this value in a normal curve would be near 530 points. By referring to Table VIII the extent of the tendency of the importance scores of all abilities to run high is indicated by the overall percentage of 78.7, a point which is more than one-half the distance between "moderate" and "essential" on the importance scale in a positive direction.

The calculated value of the training mean is 230 points, and this represents a percentage score of 55.1, computed on the basis of highest possible score. This percentage falls slightly above the "moderate" level on the training scale for the entire list of 110 scores.

The overall agreement between the training scores and the importance is shown by the Pearson coefficient of correlation of .604. For an N of 110 the test for significance at the one percent level is .23. The relationship is therefore, high positive, as between these two distributions.

The second analysis of relationships between the training and the importance of items is shown by the coefficients of correlation in Table XII. The purpose of this step in the analysis is to show the specific points of agreement, or lack of it, among the individual items, by comparing the variability of item scores within each unit, one subarea at a time. Again, the statistic rho has been used to compute the extent of this relationship. The values of rho, as listed in this table seem to bear out the overall finding of general agreement as was shown to exist in the preceeding step.

TABLE XII

EXTENT OF AGREEMENT BETWEEN THE TRAINING AND IMPORTANCE OF 110 FARM-SHOP ABILITIES TAKEN ONE SUBAREA AT A TIME

Subarea	Rho
General Principles	.66**
Forge Work	.52
Cold Metal	.62
Sheet Metal	.68*
Pipe Fitting	.61
Arc Welding	.74**
Oxy-acetylene Welding	.88**
Rope Work	.71**
Tool Care	.31

** 1 percent level
* 5 percent level

The N's vary in each subarea, therefore the test of significance for rho is different in each instance. Five of the coefficients listed in Table XII are statistically significant, while the other four are positively related, and two of the latter are near the five percent level. The least agreement exists between abilities, by subareas, in tool fitting where rho .31, is very low for an N of seven. This finding is important to the study, in view of the high place of importance that tool care occupies in the overall picture. The lack of high agreement, rho .52, in forge work seems to be of little importance because of the extremely low position that subarea occupies in farm shop. The other two areas where the coefficients are not statistically significant are of average importance in farm shop, while the rho's of .62 and .61, are, themselves, near the five percent level, so this area of low agreement is not critical, all things being considered.

The data presented in this connection indicate a generally positive state of agreement between size of importance scores and training, as the "drift" of the scores on the correlation table show.

The situation with respect to the general level of training is difficult to assess. The mean of the total distribution of training scores falls above the moderate position of the scale of training at 55 percent, however, when compared to the <u>average level</u> of the importance scores the training is not seen in a favorable light. Whether the importance scores are, generally, too high in an absolute sense cannot be determined by the data in hand.

Individual Item Relationships as Portrayed by a Scatter Diagram

The purpose of this section of the individual-ability analysis is to show the distributions of the importance and

training scores on a scatter diagram to illustrate various relationships and to provide a means of classification of the individual items with respect to level of training, level of importance, degree of harmony, and implications for change in the training emphasis.

Figure 6 is an adaptation of a correlation table where the importance scores are taken as the x-variable, and the training scores are taken as the y-variable. There is one important difference between the diagram in Figure 6 and a regular correlation table namely, a definite percentage of items, or numbers, are taken as the uniform step-intervals in constructing this figure, whereas a correlation table is constructed on a uniform score-scale, and numbers of items are allowed to vary. The method illustrated in Figure 6 relates a given level of importance to a given level of training based on quintile division of the two distributions.

The diagram in Figure 6 was constructed by dividing each of the two distributions of scores into five approximately equal parts. The cutting points were determined by calculating the first, second, third, and fourth quintile points in the distribution. Abilities, by score value, falling into each of the five step-intervals were classified by intervals as shown in Table XIII.

The data in Table XIII show that the numbers of items have been adjusted in order to include all scores of equal value in the same interval.

Fig. 6. Scatter diagram of 110 farm-shop abilities

Y-Training Scores	X-Importance Scores 420-735	740-810	815-895	900-950	955-1030	N
315-370	O	D5,D7 H7,H5,H8 O	D1,D6,D8 H4,H11 O	C3 G8 I4 S	F3,F4,F5,F8 F15 G3,G4,G10 G16 H	22
270-310	O	C8 D3,D9 H1,H2,H6 H12 O	C1,C5 E2,E4 F11 S	A2 E3 F1 I5 H	A-1,A3,A12 F16 G2,G17 I3 S	23
215-265	D2,D12 H10 O	C6 D4 S	C2,C4,C7 D11 E6 G7,G9 H	A6,A14 E1,E5 F6 I6 S	A4,A5,A10 U	21
135-210	B6,B9 D10 G5 H13 S	F2,F7,F9 H3 H	C9 G12 G15 S	A7,A-11 A15 A16 F10,F14 G1,I-1,I2 U	A9 I-7 U	23
30-130	B1,B2,B3 B4,B5,B7 B8,B10,B11 F12,G6,G13 G14 H9 H	A8 E7,E8 G11 S	E9 U	F13 U	A13 U	21
N	22	22	21	23	22	

Legend
1. Combination letters numbers refer to symbols of abilities.
2. "H" refers to high agreement.
3. "S" refers to satisfactory agreement.
4. "O" refers to overemphasis of training.
5. "U" refers to underemphasis of training.

TABLE XIII

CHARACTERISTICS OF SCATTER DIAGRAM

Importance Scores X-Variable			Training Scores Y-Variable		
Interval No.	No. of Abilities Included	Score Range	Interval No.	No. of Abilities Included	Score Range
1	22	420-735	1	21	30-130
2	22	740-810	2	23	135-210
3	21	815-895	3	21	215-265
4	23	900-950	4	23	270-310
5	22	950-1030	5	22	315-370

The diagram, shown in Figure 6 is composed of twenty-five cells and has been completed by entering each ability in its proper cell. A symbol corresponding to the original order of arrangement of the list of abilities has been used to identify each item: A-1, refers to subarea general principles, item 1, "planning school-farm shops ---". Each ability has two scores, each of which must be considered in entering the item on the diagram, as an example, importance 970 and training 310. The score 970 falls into the fifth step-interval, while the training score 310 falls into the fourth interval of the y-axis. A-1 thus has been entered in the fourth row of cells, counting from the bottom, and is located in column five.

There are four types of relationships depicted in the diagram and these are defined as follows:

1. High agreement, designated as "H", denotes a relationship that exists when the training score and the

importance score of an ability fall in equal step-intervals. The center diagonal row of five cells running from the upper right hand corner to lower left hand corner of the diagram represent the area containing the high agreement area.

2. Satisfactory agreement, denoted by "S", refers to the abilities that have training scores falling in an interval adjacent to the importance interval either above or below. The two diagonal rows of cells adjacent to the "high agreement" row represent the satisfactory agreement zone. Of the eight cells found in this area, four are above the perfect agreement row and four are located below it.

3. Overemphasis of training, designated by "O", represents an ability score on the training scale that exceeds its importance score by one or more full intervals, that is, at least one score interval separates the two measures. This area is located in the upper left hand corner of the diagram and contains a total of six cells. It is possible for the training score to exceed the importance by four full intervals.

4. Underemphasis of the training, symbolized by "U", is the opposite of overemphasis as defined in item 3, above. This cluster of six cells is located in the lower right hand corner of the diagram.

By noting the position of a given ability, in the diagram, in relation to the interval scales of both variables, it is thus possible to assess three statuses of that item. The name of the ability can be identified by checking the symbol against the original list.

Figure 6 illustrates the dispersion of the scores when plotted on this type of diagram, and the cases of "underemphasis" as well as "overemphasis" of the training, are easily located. The extent of the overemphasis is measured by listing the items in the upper left hand portion of the diagram, beginning with the diagonal row of cells one full cell-row removed from the high-agreement row. This includes six cells, however, two cells in this area are vacant.

The four cells representing overemphasis of training contain a total of twenty abilities categorized as follows:

C.	Cold Metal	1 ability
D.	Sheet Metal	9 abilities
H.	Rope Work	10 abilities
	Total	20 abilities

Of the twenty abilities in the overemphasized classification it is noted that nineteen of them belong in two subareas. These data agree with the analysis of the subareas which indicated that the importance and training were out of agreement in these two units.

The extent of the underemphasis is determined by counting the number of items found in the six cells in the lower right hand corner of the scatter diagram and these are classified as follows:

A.	General principles	9 abilities
E.	Pipe fitting	1 ability
F.	Arc welding	3 abilities
G.	Oxy-acetylene welding	1 ability
I.	Tool care	3 abilities
	Total	17 abilities

By referring to the diagram it will be noted that one ability, included in the "under" class listed above, is out of agreement to the extent of five intervals. Thirty-eight abilities are classifed as high in agreement, however, fourteen of these are located in the first interval of importance and training.

The abilities included in the two diagonal rows of cells containing the scores designated as satisfactory in agreement, include thirty-five, and these, added to the thirty-eight items above yield an overall total of seventy-three cases of satisfactory and high agreement. This amounts to 66.3 percent of the total distribution of 110 items on the list, while the number of abilities in the underemphasis class is 15.4 percent of the total. The overemphasis group of 20 abilities turns out to be 18.2 percent of the total.

The data presented in this section show that there are some areas of rather sharp disagreement between the importance and training emphasis given to certain types of abilities. Quite a lot of the high and satisfactory agreement is centered in and around the two lowest intervals of importance and training.

An overview of the data presented shows the following facts:

1.	Rope work -- overemphasized	10 abilities
2.	Sheet metal - overemphasized	9 abilities
3.	General principles -- underemphasized	9 abilities
4.	Arc-welding -- underemphasized	3 abilities
5.	Tool care -- underemphasized	3 abilities

The "satisfactory" group is not dealt with here but is further analyzed in later sections of the study. The scatter diagram shows that twenty-two ability scores are included in the lowest step-interval of importance, as follows:

B. Forge work	11 abilities
D. Sheet metal	3 abilities
G. Arc and oxy-acetylene	5 abilities
H. Rope work	3 abilities
Total	22 abilities

Furthermore, it is seen by examining the second-step interval of importance that most of the remaining items in sheet metal and rope work fall into that class, thus, the majority of the abilities in these three subareas are located in the two lowest intervals.

These data show that forge work is not rated as an important element in farm shop work. Rope and sheet metal rate relatively low in importance, but the diagram shows that a few abilities in these two units have relatively high scores. Three or four items, representing a rather technical level of

TABLE XIV

CHANGES INDICATED IN THE TRAINING EMPHASIS IN THE

THREE HIGHEST LEVELS OF FARM-SHOP ABILITIES*

Interval	Abilities Listed by Intervals in the Importance Distribution, Showing Nature of Change Indicated by the Data		Abilities Listed by Intervals in the Training Distribution, Showing Nature of Change Indicated by the Data	
	Increase Training in	Decrease Training in	Increase Training in	Decrease Training in
5				
Score Ranges: Training 315 - 370 Importance 955 - 1030	A4, A5 A9, A10 A13, A17	None	None	D1, D5, D6, D7 D8, H4, H5, H7 H8, H11
4				
Scores Ranges Training 270 - 310 Importance 900 - 950	A7, A-11, A15 A16, F10, F13 F14, G1, I1, I2	None	None	C8, D3 D9, H1 H2, H6, H12
5				
Scores Ranges: Training 215 - 265 Importance 815 - 895	E9	D1, D6, D8 H4, H11	A4, A5 A10	D2, D12 H10
Totals	17	5	3	20

* Levels refer to intervals as illustrated by Fig. 6.

skill in oxy-acetylene are at the bottom of the list in importance, although in general, this subarea ranks high in importance.

The top twenty-two scores come, largely, from the units of general principles, arc welding, and oxy-acetylene welding. The fourth interval of importance, also, contains several items from the unit of general principles, arc welding, oxy-acetylene welding, pipe fitting, and tool care. The majority of abilities in the third interval belong in those subareas, and a few items from sheet metal and cold metal, in addition.

The overall training was highest in sheet metal, rope work, arc and oxy-acetylene welding, and cold metal work, as indicated by the number of abilities found in the two top rows of cells.

The data show that there is a "bunching" of high-scored abilities in, and below the third step-interval of the training which throws the agreement out of balance. The low training emphasis given to the subarea of forge work, however, is in line with the importance of that unit, and the strong training emphasis that is shown by the concentration of abilities found in the upper right hand corner of the diagram is suggestive of a strong training emphasis in those subareas of high importance.

Digest of Data Relative to Some Changes in the Training Emphasis of Farm-Shop Abilities

The digest presented in this phase of the analysis represents data which have been extracted from the scatter diagram as shown in Figure 6. This presentation is, therefore, considered to be complementary to the preceeding section of the study which related to the analysis of score dispersion. The purpose of this phase of the investigation is to present, in digest form, the changes that are indicated as being necessary to bring the training and importance into closer agreement. By referring to the diagram in Figure 6, it can be noted that two types of changes are, thus, indicated and these are presented in Tables XIV and XV.

Table XIV shows the changes in training emphasis that are supported by the criterion of at least one full interval of buffer zone between the interval levels of the two variables of a particular ability. Such changes may refer to either increases or decreases in the training emphasis and would represent a relationship between the two variables of an ability such as, "importance interval 5, training interval 3", or the opposite relationship could exist.

The second type of change in training emphasis represents the fringe-area relationships which are identified as the eight cells on the scatter diagram in Figure 6, labeled as the "satisfactory zone". Abilities lying in the fringe area possess relationships such as, "importance interval 5, training interval 4", or the opposite relationship could exist. The fringe-area "suggested" changes, presented in this section, are not supported by the statistical criterion that applies to the first type of changes; suggested shifts in training emphasis listed in this analysis are subject, therefore, to careful study and consideration as a possible means of obtaining closer agreement between the importance and training statuses of the items thus classified -- they are not advocated as definite changes.

It is important to note that changes in the college instructional program in farm shop occurring since the teachers were in college would tend to nullify these suggestions.

The presentation of data in Table XIV represents the changes that are indicated in the interval-levels of both variables, i.e., the changes in the fifth interval refer to the fifth interval of the training distribution and the fifth interval of the importance distribution; the population is thus, considered to be all of the abilities falling in both distributions, and percentages are computed on that basis. Some duplication is encountered in this type of analysis because the interval bands cross at some point on the diagram. Still another type of duplication encountered is referred to as reciprocal effect, i.e., "needed increases" that have been recorded in the fifth interval of importance will necessarily fall in the increase zone of the training distribution at a lower interval level. In order to avoid distortion of percentages, all increases and decreases are counted in both distributions, and the population is counted likewise.

Definite training changes indicated. By studying the data in Table XIV the definite training changes that fall into the upper three levels of both variables are as follows: five of the six indicated increases come from the general principles subarea, while the other item belongs in the unit, tool fitting; of the ten decreases listed, five are sheet metal abilities and five relate to rope work. The nature of these items can be found by checking the next section, "itemized statement---." which lists each ability by name.

The fourth intervals of the distributions contain ten increases, again, headed by four items belonging in general principles, and followed by three abilities in arc-welding, one in oxy-acetylene welding, and two items in tool care. The seven decreases listed in this level are headed, as in the fifth level, by four abilities from the unit of rope work. Two other items in the decrease category belong in sheet metal, while one ability comes from the unit of cold metal work.

The third intervals contain four indicated increases in the training emphasis of three abilities in the unit of general principles and one item in pipe fitting. The indicated decreases are, again, for abilities belonging in rope and sheet metal. These latter changes represent duplication from reciprocal effect.

The twenty increases found in the three highest intervals of the two distributions involve the subareas of general principles, arc-welding, tool fitting, oxy-acetylene, and pipe fitting, but the majority of these items belong in one unit, namely, general principles.

The twenty-five decreases in training, listed in these highest levels on both scales, include abilities from the units of rope work, sheet metal, and one item from cold metal.

The twenty increases represent 15.1 percent of the total population of abilities in both variables, while the twenty-five decreases in the training emphasis represent 18.9 percent of the total. Altogether, the increases and decreases represent 34.1 percent of the total number of abilities included in the three highest intervals. In the main, these changes relate to: increases in the training in general principles, and decreases in rope and sheet metal work.

Fringe-area changes suggested. This section of the analysis presents suggestions, or possibilities, for changing the training emphasis so as to bring the two variables of the "fringe-area" abilities into closer harmony. Even though the increments of gain in harmony would likely be small in individual cases, there are a large number of abilities lying in the fringe zone that represent such possibilities. The limitations of this type of analysis have been discussed in a previous section of the study, and in this connection, the lack of proper statistical support should be kept in mind in checking the data.

Table XV lists a total of seven suggested increases in the fifth levels and three of these items belong in general principles, one in arc welding, two in oxy-acetylene welding, and one in tool fitting; the three suggested decreases in the same levels are abilities from the units of oxy-acetylene, tool care, and cold metal work, each of which is represented by one ability.

The fourth level, in the two distributions, contain thirteen suggested increases and these are distributed as follows: five abilities in general principles, three items in arc welding, three abilities from the unit of oxy-acetylene welding, three abilities in tool care, and one item from the unit of cold metal work. The eight suggested decreases in the fourth levels involve three items in cold metal work, two abilities in pipe fitting, one item from the unit of arc welding, two abilities in oxy-acetylene welding and one item from the subarea of tool fitting.

The third levels, of the two distributions, contain nine suggested increases and seven decreases. A majority of these changes represent the reciprocal effect of changes already listed in the fourth and fifth intervals. The items that represent new suggested changes in training emphasis, i.e., not covered by reciprocal effect, involve increases in two oxy-

TABLE XV

FRINGE-AREA* CHANGES SUGGESTED IN THE TRAINING EMPHASIS OF THE THREE HIGHEST LEVELS OF FARM SHOP ABILITY SCORES

Interval	Abilities Listed by Intervals in the Importance Distribution, Showing the Nature of Change Suggested by the Data		Abilities Listed by Intervals in the Training Distribution, Showing the Nature of Change Suggested by the Data	
	Increase Training in	Decrease Training in	Increase Training in	Decrease Training in
5				
Scores Ranges: Training 315 - 370 Importance 955 - 1030	A-1, A3, A12 F16, G2, G17 I3	None	None	C3, G8, I4
4				
Scores Ranges: Training 270 - 310 Importance 900 - 950	A6, A14, E1 F3, F6, I6	C3, G8, I4	A-1, A3, A12 F16 G2, G17 I3	C1, C5 E2, E4 F11
3				
Score Ranges: Training 215 - 265 Importance 815 - 895	C9 G12, G15	C1, C5 E2, E4 F11	A6, A14 E1, E5 F6 I6	C6 D4
Totals	16	8	13	10

*Fringe-area refers to abilities having importance and training scores in adjacent score-intervals on the frequency distribution.

acetylene abilities and one cold metal item; the decreases in training involve one cold metal ability and one sheet metal item. The names and nature of these items can be checked in the following section where the itemized statement of the complete list of 110 abilities appears.

The fringe-area suggested changes presented in the preceding analysis includes a total of twenty-nine increases in the training emphasis, or 22 percent of the total number of abilities lying in the three highest levels, counting both distributions; the eighteen decreases that are suggested represent 13.6 percent of the total number in these highest levels. Altogether, the forty-seven suggestions for shifting the emphasis represent 35.6 percent of the total number of abilities included.

The ninety-two items included in both categories of changes represent 69.0 percent of the total populations of both interval bands; these are divided almost equally between the changes and suggested changes.

Itemized Statement of 110 Farm-Shop Abilities

The purpose of this section of the analysis is to present the entire list of farm-shop abilities, showing (1) the importance level*, (2) training level*, and (3) extent of agreement existing between the importance and training levels of each item. In this particular phase of the anslysis, the

* Level and interval are used interchangeably to designate division of the distributions; see Figure 6.

abilities are identified by name as they appeared on the original survey forms. It will be noted that the abilities were referred to by symbol instead of by name in previous analyses. Each ability is rated in accordance with the three statuses, as specified above, and these data have been gleaned from Figure 6, as presented in the preceding section.

The first column in Table XVI to the right of the names of the abilities refers to the importance interval, which is the same as that used in connection with the scatter diagram shown in Figure 6.

To illustrate the method used to determine the levels of the training and importance scores of each ability the following example is given: the first ability listed in farm shop is referred to as A-1, and it is located in the fifth column, or fifth interval of the diagram. This interval ranges from 955 to 1030 points inclusive--the highest 20 percent of the scores. The ability A-1 has a score of 970 points. Since the score 970 falls in the fifth interval the number "5" has been entered by A-1 in Table to indicate its importance status.

The second column in Table XVI, referring to the training status, is obtained by the same method as described above for the importance status. An example of the method of evaluating one ability as to its training status ability A-1, has a training score of 310 points, which belongs in the fourth

TABLE XVI

ITEMIZED STATEMENT RELATIVE TO THE IMPORTANCE, TRAINING, AND EXTENT OF AGREEMENT OF 110 FARM-SHOP ABILITIES

Abilities Included in This Area	Final Standing of Each Ability in Regard To:		
	Importance Interval*	Training Interval*	Extent of Agreement**
A. General Principles -- Ability to			
1. Plan school-farm shops according to the instructional needs in the community	5	4	S
2. Plan school and home-farm shops in accordance with the economic status of local agriculture.	4	4	H
3. Plan school and home-farm shops in accordance with functional requirements.	5	4	S
4. Select and purchase desirable equipment for school-farm shops	5	3	U
5. Use basic shop equipment effectively.	5	3	U
6. Store shop equipment effectively.	4	3	S
7. Purchase and store shop supplies.	4	2	U
8. Design and apply adequate safety color system to the walls and equipment in school shops.	2	1	S
9. Maintain and repair shop equipment commonly found in farm mechanics shops.	5	2	U
10. Select shop work for instruction in accordance with economical practice and training value of each job.	5	3	U
11. Plan shop jobs to show cost, labor, and correct design.	4	2	U
12. Enforce the use of safety measures in school shops.	5	4	S
13. Apply first aid treatment in case of shop accidents.	5	1	U
14. Locate and use available resource materials.	4	3	S

* 1, 2, 3, 4, 5 refer to relative position of the ability-score in the distributions of importance and training. Refer to Fig. 6.

** Extent of agreement refers to the relative positions of both training and importance intervals of each ability; "H" refers to high agreement, "S" denotes satisfactory agreement, "U" refers to underemphasis of the training, "O" denotes overemphasis. Refer to Fig. 6.

TABLE XVI (Cont.)

Abilities Included in This Area	Final Standing of Each Ability in Regard To: Importance Interval	Training Interval	Extent of Agreement
15. Establish and follow desirable policies of public relations in the use and operation of school shops.	4	2	U
16. Maintain inventories of equipment and supplies.	4	2	U
B. Forge Work -- Ability to:			
1. Build and maintain a satisfactory forge fire.	1	1	H
2. Measure and mark stock for various forging operations.	1	1	H
3. Heat stock for various forging operations.	1	1	H
4. Draw stock to desired shape.	1	1	H
5. Upset stock to desired shape.	1	1	H
6. Bend stock to dimensions.	1	2	S
7. Forge-weld steel	1	1	H
8. Recondition plow shares.	1	1	H
9. Temper tool steel	1	2	S
10. Anneal hardened steel	1	1	H
11. Cut hot stock to dimensions.	1	1	H
C. Cold Metal Work -- Ability to:			
1. Measure and mark cold metal stock accurately.	3	4	S
2. Select correct hack saw blades and cut various kinds of metal.	3	3	H
3. Drill accurate holes to dimensions.	4	5	S
4. Select correct taps and cut inside threads.	3	3	H
5. Select correct dies and cut outside threads.	3	4	S
6. Reverse dies and clean-up damaged threads.	2	3	S
7. Bend cold stock to accurate dimensions.	3	3	H
8. Rivet metal together.	2	4	O
9. Select proper files and do various filing operations.	3	2	S

TABLE XVI (Cont.)

Abilities Included in this Area	Final Standing of Each Ability in Regard To: Importance Interval	Training Interval	Extent of Agreement
D. Sheet Metal and Soldering -- Ability To:			
1. Measure, mark, and cut stock to dimensions.	3	5	O
2. Lay out radial patterns.	1	3	O
3. Bend sheet metal to dimensions.	2	4	O
4. Do simple forming operations.	2	3	S
5. Shape and tin soldering coppers.	2	5	O
6. Solder a lap seam	3	5	O
7. Solder a hook seam.	2	5	O
8. Sweat on a patch.	3	5	O
9. Rivet sheet metal together.	2	4	O
10. Cut stove pipe or other similar surfaces.	1	2	S
11. Operate a blow torch.	3	3	H
12. Lay out various kinds of seams.	1	3	O
E. Pipe Fitting - Ability to:			
1. Select correct pipe size and type for a given job.	4	3	S
2. Compute required lengths of pipe for a given job and cut to dimensions.	3	4	S
3. Cut pipe threads properly.	4	4	H
4. Ream pipe to specifications after being cut.	3	4	S
5. Select pipe fittings for a given job.	4	3	S
6. Assemble pipe and pipe fittings and tighten correctly.	3	3	H
7. Cut out damaged section of pipe from a fixed line and repair in place.	2	1	S
8. Prepare a standard bill of materials of pipe and pipe fittings for a given job and estimate cost.	2	1	S
9. Sweat copper pipe joints.	3	1	U
F. Arc Welding -- Ability To:			
1. Select and purchase the most desirable arc welder for the school or home-farm shop.	4	4	H

TABLE XVI (Cont.)

Abilities Included in This Area	Final Standing of Each Ability in Regard to: Importance Interval	Training Interval	Extent of Agreement
2. Maintain and repair arc welder and accessories.	2	2	H
3. Assemble arc welding equipment and adjust current for welding.	5	5	H
4. Do satisfactory flat position welding.	5	5	H
5. Do satisfactory horizontal position welding.	5	5	H
6. Do satisfactory vertical position welding.	4	3	S
7. Do satisfactory overhead position welding.	2	2	H
8. Make satisfactory welds of various types, i.e., butt, lap, fillet, corner.	5	5	H
9. Do satisfactory brass welding with the carbon arc torch.	2	2	H
10. Apply hard surfacing material.	4	2	U
11. Cut metal and punch holes with the arc welder.	3	4	S
12. Apply solder with special arc welder attachment.	1	1	H
13. Weld cast iron.	4	1	U
14. Build up worn surfaces.	4	2	U
15. Practice and enforce safety measures in the use of arc welding equipment.	5	5	H
16. Recognize and analyze welding errors.	5	4	S
G. Oxy-acetylene Welding -- Ability to:			
1. Select and purchase the most desirable oxy-acetylene welding equipment for the school or home-farm shop.	4	2	U
2. Assemble oxy-acetylene equipment for various processes.	5	4	S
3. Adjust gages and flame for various processes.	5	5	H
4. Do satisfactory flat position welding.	5	5	H
5. Do satisfactory vertical position welding.	1	2	S
6. Do satisfactory overhead position welding.	1	1	H

TABLE XVI (Cont.)

Abilities Included in This Area	Final Standing of each Ability in Regard to: Importance Interval	Training Interval	Extent of Agreement
7. Do satisfactory horizontal position welding.	3	3	H
8. Make satisfactory welds of various types, i.e., butt, lep, edge.	4	5	S
9. Do satisfactory brass welding.	3	3	H
10. Cut metal with the cutting torch.	5	5	H
11. Weld pipe satisfactorily.	2	1	S
12. Apply hard surfacing materials.	3	2	S
13. Fuse weld cast iron.	1	1	H
14. Apply hard solder (silver).	1	1	H
15. Test equipment for leaks or other defects.	3	2	S
16. Practice and enforce safety measures in all oxy-acetylene welding.	5	5	H
17. Identify various welding errors.	5	4	S
H. Rope Work -- Ability to:			
1. Select type and size of rope for a given need.	2	4	O
2. Store rope correctly.	2	4	O
3. Calculate strength and safe load for a given size of rope.	2	2	H
4. Tie common knots.	3	5	O
5. Make common loops.	2	5	O
6. Make common hitches.	2	4	O
7. Make long splice.	2	5	O
8. Make short splice.	2	5	O
9. Reeve a set of blocks.	1	1	H
10. Determine mechanical advantage in a given set of blocks.	1	3	O
11. Finish the ends of rope for permanence.	3	5	O
12. Make cattle halters.	2	4	O
13. Make casting tackle for various farm animals.	1	2	S
I. Tool Care -- Ability To:			
1. Select correct grinder wheels for various uses.	4	2	U
2. True up grinder wheels.	4	2	U
3. Grind drill bits.	5	4	S

TABLE XVI (Cont.)

Abilities Included in this Area	Final Standing of Each Ability in Regard to: Importance Interval	Training Interval	Extent of Agreement
4. Grind cold chisels.	4	5	S
5. Dress up punches.	4	4	H
6. Install shop tool handles.	4	3	S
7. Repair, service, and maintain common tools and equipment found in school-farm shops.	5	2	U

interval of training and the number "4" has, therefore, been entered as the symbol for the training status.

The third column in Table XVI refers to the extent of agreement, and this information has been extracted from the diagram in Figure 6; the symbols used to designate the harmony between the training and the importance are the same as those in that diagram, that is, the H, S, U, and O refer to the extent of agreement as high, satisfactory, underemphasis, overemphasis respectively. For further details refer to previous section of this study.

This table does not present new data but does present the essential facts relating to individual abilities in a different type of organization which provides the name of each ability and the data relative to the three statuses of each. Both types of presentation--scatter diagram and individual-item standing--seem to have necessary functions in the analysis. The diagram shows the overall situation with respect to dispersion of the abilities, areas out of agreement in the overall distribution of training and importance, general picture of importance and training by various levels, and the like; the present method is used to show exactness of detail with respect to the status of each ability in farm shop, and these data are presented for each item as it appeared in its original setting. The subareas are maintained, intact, for reference in course planning.

It can be determined, by checking the data for a few of the items in the present listing, that the most important features pertaining to the 110 individual abilities in the farm-shop area have been presented in the preceeding section, relative to the analysis by scatter diagram. The nature and extent of the several classifications of farm-shop abilities was discussed in that phase of the study including (a) detailed information relative to specific abilities included in the high, low, and medium groups according to score intervals, (b) detailed analysis of specific abilities included in groups classified according to areas of agreement, and (c) detailed analysis of changes suggested in the training emphasis of specific abilities in various score intervals of the distribution.

This phase of the investigation has presented the list of 110 farm-shop abilities by name, and by subareas, as they appeared on the survey forms. The status of each item has been presented with reference to its levels of importance and training, and the extent of agreement existing between these two levels, in terms of a statistical criterion. The essential points relative to each subarea of abilities have been presented under the headings of the subarea names.

The main points relating to the individual abilities in each subarea, are presented in the subsequent material.

1. The first subarea on the list contains sixteen abilities classified under the title of general principles, which are sometimes referred to as "fundamentals of farm shop".

Fifteen, of the sixteen items in this unit, are found in the upper three intervals of training. The large number of abilities located in the cells of underemphasis indicates that the training is out of balance in the low direction. A total of nine items are checked as underemphasized.

2. The eleven abilities in forge work represent the lowest subarea, as a unit, in the study. All items in this unit fall into the lowest level of importance. The training is in high agreement with the importance, as indicated by the majority of H's. Only two abilities in this subarea are found above the first interval of training and these are located in the second level.

3. Cold metal work is found to be above average in importance in farm shop, based on the status of abilities included. The unit contains nine abilities; and seven of these are located in the upper three levels of importance. The training, in a majority of the abilities, is in harmony with the importance levels of the individual items with eight falling into the upper three levels of training.

4. A majority of the abilities included in sheet metal work are located in the low brackets of the importance distribution. The training scores of sheet metal abilities, however, are found in the high levels of the training distribution. The resulting relationships are signified by a large majority of instances of overemphasized training.

5. The majority of the abilities listed in pipe fitting have above-average score-levels in importance, although a few fall in the second interval on the scale. The training in pipe fitting seems to be in agreement with the importance as indicated by the large number of abilities found in the "S" and "H" cells.

6. The presence of eleven arc welding abilities in the upper two intervals is evidence of the high importance given the majority of items in this unit. Four abilities in arc welding, however, are located in the two lowest brackets of importance; a study of these items shows that they are activities of a specialized nature.

The training is in agreement with the importance in most of the sixteen abilities, only three instances of underemphasis being noted.

7. The situation in oxy-acetylene unit is very similar to that found in arc welding, that is, the importance of a majority of the seventeen items is high on the scale, however, abilities including five specialized types of activities are found in the lowest two brackets. The sixteen marks of high and/or satisfactory indicate that a high level of agreement exists between the training and importance scores in this subarea. Only one case of underemphasis is noted on the list of seventeen items. Twelve items, of the seventeen on the list, are found in the upper three intervals of importance.

8. The subarea of rope work contains thirteen abilities, but only two have scores on the scale as high as the third interval of importance. The other eleven are located in the two lowest intervals on the importance scale. In contrast to the low status of importance, the training level averages almost four, and a state of disagreement between the training and the importance scores is indicated by the ten marks for overemphasis.

9. Although the number of abilities included in the area of tool care is not large, the seven items studied are located in the fourth and fifth intervals of importance, thus signifying that activities relating to tool fitting are important in the area of farm shop. The training picture is out of harmony with the importance of the tool care abilities. The relationship is indicated by the six marks for underemphasis.

The high percentage score of the unit, tool care, has been shown, and used, in previous analysis, and it should be noted that there are only a small number of abilities included in this block and this must be considered as a factor in final evaluation of units.

Digest of Data Relative to Selected Factors of the Item Analysis

This section of the study represents a digest of data related to selected factors of the item analysis and is considered to be complementary to that analysis. Table XVII is organized

TABLE XVII

COMPARISON OF THE TRAINING AND IMPORTANCE STATUS OF ABILITIES LOCATED IN THE FIVE SCORE INTERVALS*

Subarea	No. of Abilities in each Subarea	Number of Abilities Occurring in Each Interval, by Subareas: 5th		4th		3rd		2nd		1st		Total No. of Abilities in Three Highest Levels		Rank of Subareas	
		Imp.	Trn.	Imp.	Trn.	Imp.	Trn.	Imp.	Trn.	Imp.	Trn.	Imp.	Trn.	Imp.	Trn.
A. General Principles	16	8	0	7	4	0	5	1	5	0	2	15	9	1	4
B. Forge Work	11	0	0	0	0	0	0	0	2	11	9	0	0	9	9
C. Cold Metal Work	9	0	1	1	3	6	4	2	1	0	0	7	8	5	6
D. Sheet Metal	12	0	5	0	2	4	4	5	1	3	0	4	11	7	1
E. Pipe Fitting	9	0	0	3	3	4	3	2	0	0	3	7	6	5	7
F. Arc Welding	16	6	5	5	3	1	1	3	5	1	2	12	9	2.5	4
G. Oxy-acetylene Welding	17	6	5	2	2	4	2	1	4	4	4	12	9	2.5	4
H. Rope Work	13	0	5	0	4	2	1	8	2	3	1	2	10	8	2
I. Tool Care	7	2	1	5	2	0	1	0	3	0	0	7	4	5	8
Totals	110	22	22	23	23	21	21	22	23	22	21	66	66		

* See Fig. 6 to determine interval for any particular ability.

to show: (1) the number of abilities occurring in each of the five score-intervals of importance and training, by subareas, (2) the sums of the number of abilities found in the upper three intervals of importance and training by subareas, (3) the rank order of each subarea based on the highest number of abilities found in the upper three levels of importance and training. The companion Table XVIII shows the numbers of abilities in each subarea of farm shop classified according to: (a) managerial, (b) operative or manipulative, (c) combination of (a) and (b), and (d) average interval levels of different types of abilities.

The data on which Table XVII is based show how the abilities within each subarea are distributed, with respect to the number occurring in Figure 6. The digest material presented in this table makes is possible to see the entire picture of the score-level distributions at once. As an example, it is apparent that fifteen abilities in A, general principles, are found in the fourth and fifth intervals, while B, forge work, does not have a single ability in the upper four levels, that is, every item in forge work is located in the lowest interval of importance.

The second feature of this digest shows the situation when the abilities in the upper three intervals are summed up as a separate unit. The latter analysis reveals that three units predominate in the numbers of abilities occurring in the upper levels, namely, general principles leads with fifteen items, arc and oxy-acetylene welding follow with twelve abilities each. Following are three subareas tied for fourth place, each represented by seven items, these are cold metal, pipe fitting, and tool care.

Sheet metal with four abilities, and rope with two, barely get into the picture, when the sum of items in the three top intervals are used as a basis of rank. On this basis, the rank of subareas is somewhat different than it was found to be in the previous analysis in which the ranks were based on the magnitude of percentage scores. The present method shows the importance in a more restricted or more specific way; it does not take account of the abilities of lesser importance which, nonetheless, have to be considered in a total shop program. This presentation does emphasize general principles, and the two welding units, in a stronger way than in the former analysis; tool care drops in overall importance because of the small number of abilities in that unit.

The third division of the digest, as depicted in Table XVIII, indicates the numbers of abilities in each subarea classified by types. The totals, as shown in that table, include the following: twenty-one abilities are listed as managerial type; seventy-five items are classed as manipulative, the remaining fifteen are designated as comtination type.

The four rows of data near the bottom of the table list averages of the different types as compared to the average score level of the entire distribution. As an example of the

TABLE XVIII

NUMBER OF ABILITIES IN EACH SUBAREA, CLASSIFIED AS TO TYPES AND SCORE LEVELS*

Subarea	Number of Managerial Abilities Included	Number of Manipulative Abilities Included	Number of Combination Abilities Included
A. General Principles	10	2	4
B. Forge Work	0	11	0
C. Cold Metal Work	0	5	4
D. Sheet Metal Work	0	12	0
E. Pipe Fitting	3	5	1
F. Arc Welding	2	12	2
G. Oxy-acetylene Welding	2	13	2
H. Rope Work	3	9	1
I. Tool Work	1	5	1
Totals	21	74	15

	Score Levels	
	Importance	Training
Average interval level of 21 managerial abilities.	3.9	3.0
Average interval level of 15 combination abilities.	3.5	3.2
Average interval level of 74 manipulative abilities.	2.6	3.0
Average interval level of 110 farm shop abilities.	3.0	3.0

* Refer to Fig. 6 for definition of level or interval.

method of computation, these data were obtained by tallying the importance-interval values of the twenty-one managerial abilities and by converting the total to an average level; the same method was applied in computing the averages of other types of abilities appearing in the table.

Based on the normal average level of the entire distribution (3.0) it is noted that the twenty-one managerial-type items rate the highest on the scale at 3.9, which is considerably above the distribution average. The overall average level of fifteen combination-type items fall above the distribution normal also, at 3.5, while the average importance level of seventy-five -- forge work for example -- and this tends to pull the average level of the operative abilities down. The average interval level of all three types of abilities was near the average of the entire distribution of 3.0, in the training distribution. Almost one-half of the total of twenty-one managerial abilities listed in the farm shop area belong in, or come from the area, general principles, while the other managerial items relate to the fundamental aspects of various subareas. Not only does the importance of the managerial type rate high on the scale, but the training in these items is not high.

To summarize the situation in regard to the number and percentages of different types of abilities found in the upper levels, the data reveal that:

1. Of the forty-five abilities included in the two top levels of importance, (a) seventeen are managerial, (b) twenty-one are manipulative, and (c) seven are combination type. The seventeen managerial items included in the three highest intervals of importance represented 81 percent of the total number of such abilities on the list.

2. Of the forty-five abilities in the two upper levels of training, (a) eight are managerial, (b) thirty are manipulative, and (c) seven are of the combination type.

The contrast shown by these data indicates that: (1) the training emphasis is heavy in the direction of the operative-type of abilities; (2) the managerial type tends to fall high on the importance scale; (3) the combination type tends to fall above average on the scale; (4) one unit, general principles, contains almost one-half the total number of managerial abilities in the farm-shop area; (5) of the twenty-two abilities located in the highest level of training, the operative type predominate with nineteen, (a) three combination types are found in the same level; (b) no managerial abilities are found in the highest level of training.

Teachers' Suggestions for Ability Development

Table XIX includes a summary of the suggestions made by forty-one teachers relative to the farm-shop course(s) taken as a part of their college preparation to teach the

B.

C.

D. C

E. A
1.
2.
3.
4.
5.
6.

F. Omi
1.
1.

Total N
Average

TABLE XIX

TEACHERS' SUGGESTIONS FOR IMPROVING THE DEVELOPMENT OF ABILITIES IN THE COLLEGE TRAINING PROGRAM IN FARM SHOP

	Total Number of Teachers Reporting	Total Number of Suggestions Listed
A. Add Course(s)	12	21
1. The care and repair of shop equipment		
2. Construction of shop projects		
3. Planning and organizing school-farm shops		
4. Developing plans for farm shop projects		
5. Use of demonstrations in teaching		
6. General comprehensive skills		
7. Advanced welding		
B. Omit Course(s)	0	0
1. None.		
C. Add Units of Instruction	12	28
1. Proper use of hand tools		
2. Forge work		
3. Use and maintenance of power tools		
4. Selection of shop tools		
D. Omit Units of Instruction	5	7
1. Rope work		
2. Sheet metal		
E. Add Class Activities	13	21
1. Repair and service shop equipment		
2. Build labor saving equipment		
3. Repair farm equipment		
4. Sharpen and fit shop tools		
5. Lay out and build farm trailer		
6. More "doing" type of shop work in general		
F. Omit Class Activities	7	7
1. Sheet metal projects		
1. Tying knots in rope		
Total Number Suggestions		84
Average Number of Suggestions per Teacher		2.04

farm-mechanics phases of vocational agriculture. Teachers were asked to suggest ways and means of increasing the development of farm-shop abilities in the college instructional program. The report included six divisions of suggestions relating to course content and method.

Each classification appearing in Table XIX is discussed in the order in which it was listed in the original survey forms:

Add a course or courses in farm shop. Because of the unstructured nature of the forms used it was necessary to condense the suggestions reported in this section.

The information under A, in Table XIX, shows that seven suggestions were reported as course additions. These items seem to be logical course possibilities in terms of scope and subject content; suggestions appear on the list in the order of the frequency as checked by teachers in the twenty-three reports. The use and care of shop tools ranked highest, and the construction of shop projects, followed closely in second position as courses that need to be added.

A total of twelve teachers reported the need for adding a course in farm shop work. Twenty-one suggestions are listed, including duplications.

Omit courses. This phase of the study received very little response.

Add units of instruction. After condensing the lists there are four items included in Table XIX as units to be added as follows: use of hand tools is in first rank, forge work is second, although only four respondents list this unit, use and maintenance of power tools (grinder, drill, etc.) is in third place on the list, and selection of shop tools is the other unit represented by more than one response.

Omit units of instruction. Two main items were mentioned frequently in connection with the dropping of units from the present course content; rope work was listed four times, while sheet metal was suggested three times.

Class activities to be added. Table XIX shows that thirteen teachers listed twenty-one activities under this heading. After condensing the list into workable form there were six items that have common support among the respondents. These activities are very similar in nature to the suggestions of units of instruction to be added. Repair and service shop equipment is the most common item listed, while other suggested activities include building labor-saving equipment, tool fitting, and actual repair work on farm equipment.

Omit class activities. There were fewer responses listed in connection with dropping of class activities. Seven teachers listed a total of seven suggestions. The two items that have common support relate to sheet metal and rope activities.

The information presented in this phase of the investigation appears to be in agreement with the analysis which presented the relative importance of various units and abilities in the farm-shop area. Generally speaking, teachers advocate additions and use of a more active program of shop work involving (1) tool care and (2) tool processes, along with additional, (3) instruction in project building. Teachers also tend to want more activity devoted to the planning and organizing of school-farm shops. In this connection they propose additional training in the operation and maintenance of power machinery found in school-farm shops.

Teachers' suggestions, apparently, agree with the present structure of the farm-shop course given at Michigan State University (AE 326) with respect to content, with the exception of the units in sheet metal and rope work, which they indicate should be reduced. Very little is suggested as things to omit other than the latter two items.

Supplementary Experiences of Teachers

This phase of the investigation presents information that attempts to establish the extent and nature of teachers' supplementary experiences that have contributed to their ability to teach farm-shop activities as a phase of vocational agriculture. The original design of the study assumed that the information obtained in this connection would throw some light on the problem of deciding on a reasonable beginning level of the instruction in college course work, based on the background of experiences reported by these men.

The data representing the reports from forty-one experienced teachers are shown in Table XX. A study of the data on which the table is based shows that ten types of experience are reported, and that the number of teachers reporting each type ranges from four to nineteen. The greatest percentage of participation is noted in the first item listed, practical experience acquired through living on a farm. The number reporting this item represents 46.3 percent of the total group.

According to the data in Table XX other experiences that are common to the respondents are: practical, on-the-job experience gained as a teacher, 31.7 percent reporting; employment in some type of manufacturing, 24.4 percent checking, construction work, 21.9 percent reporting; assistance from specialists, 17.1 percent reporting this type of experience.

Additional supplementary experiences that were reported by fewer teachers in each instance are as follows: mechanical work in the military service; teaching and assisting veterans in solving practical farm-shop problems; participation in in-service training clinics; working as a mechanic--hired and self-employed. Although these latter classes of experiences were not as common to the group as some that were discussed in the foregoing material, a total of seventeen teachers included these four groups of activities in their inventory of supplemental training in farm-shop area.

TABLE XX

SUPPLEMENTARY EXPERIENCES REPORTED BY TEACHERS AS HAVING IMPROVED THEIR ABILITY TO TEACH FARM-SHOP ACTIVITIES

Kind of Activity Reported	Number of Teachers Reporting	Percent of Teachers
1. Practical experience acquired through living on a farm	19	46.3
2. Contacts and experience acquired through teaching regular vocational agriculture	13	31.7
3. Employment in manufacturing	10	24.4
4. Employment and practical experience in various kinds of construction work	9	21.9
5. Assistance obtained from specialists and professional workers	7	17.1
6. Experience in some specialized type of work, such as welding, pipe fitting, etc.	7	17.1
7. Varied mechanical experiences acquired in the military services	5	12.2
8. Attendance at in-service training meetings	4	9.7
9. Experience gained through teaching veterans	4	9.7
10. Experience as auto mechanic	4	9.7

Total number of supplementary experiences reported - 82

Average number of supplementary experiences per teacher - 2

A majority of teachers included in the farm-shop phase of the investigation listed one or more supplementary experiences as having improved their ability to teach various phases of farm-shop work. There were a total of eighty-two experiences listed or an average of two per teacher.

The most essential points noted in regard to the ten classes of experiences, as reported in Table XX, are listed in successive order: (1) approximately one-half of the total number of experiences listed were included in three classifications: practical farm background, nineteen teachers reporting, practical mechanical experience acquired through teaching vocational agriculture, thirteen teachers reporting, employment in some type of factory work, ten respondents reporting; (2) the next group, in order of size, included nine teachers who listed construction work as improving farm-shop abilities.

The four types of experiences at the bottom of the list were reported by a range four to five teachers in each type. These latter four groups included a total of seventeen teachers and the nature of the experiences relate to mechanical work engaged in while in the military service, participation in in-service training clinics, teaching and working with veterans, engaging in the trade of auto mechanic.

The data presented in this phase of the investigation indicated that at least four kind of experiences were sufficiently common to the group to be taken into account as supplementary sources of teacher preparation in the farm-shop area. Farm background was most frequently reported, representing 46.3 percent of the total number of teachers included in this phase of the study, and the second most frequently reported experience was actual teaching experience; almost one-third of the group listed this item. Construction work and employment in factory work of various types were other experiences reported in this connection.

Note: The major findings have been reviewed at the end of each section of analysis in this chapter.

CHAPTER V

PRESENTATION OF THE DATA RELATIVE TO THE FARM-STRUCTURES AREA

The data pertaining to the farm-structures phase of the investigation are presented in this chapter. A total of 109 respondents checked the importance scores of seventy abilities included in this area, while thirty-nine teachers of vocational agriculture checked the training scores of the same list of seventy items. Group identity has been retained for analysis, and the presentation of data, therefore, includes (1) a summary of the importance scores of each of four groups of respondents, (2) a composite summary of importance scores representing all four groups, (3) a summary of the training scores representing thirty-nine teachers of vocational agriculture.

The group summaries of data in each instance contain (1) one overall score of each group covering the farm-structures area, (2) a subarea, or unit, score for each of seven subareas included in the farm structures phase of the study, (3) a total score for each of seventy abilities included in this area, and (4) the rank order of the subareas, as well as the ranks of the individual items within each subarea. The arrangement and presentation of the data in this chapter, generally, follow the pattern of the farm-shop chapter and the major phases of the presentation are as follows: (1) group analysis; a study of the similarities and/or differences between all combinations of group pairings, including the composite sample, and the training scores; (2) unit, or subarea, analysis; a study of the importance and training relationships among the seven units in farm structures; (3) item analysis; a study of the importance and training relationships among the seventy individual abilities on the list; (4) an assessment of teachers' suggestions for improving the development of abilities in the college instructional program in farm mechanics; (5) an assessment of the nature and extent of the supplementary experiences reported by teachers as having improved their abilities in the farm-structures area. These presentations of the data follow in the order listed in the foregoing outline.

Similarities and/or Differences of Respondents by Groups

The data relative to the extent of group differences and/or similarities are presented in three sections; (1) the overall picture of agreement, or lack of it, as revealed by the grand total of the importance scores of the entire area; (a) by groups, (b) compared with the composite scores; (2) group differences or harmony, as revealed by (a) the subarea importance scores of each group, and (b) rank correlation coefficients based on these group ratings; (3) group differences and/or similarities as revealed by the rank correlation coefficients computed by comparing the ranks of the importance scores of the abilities within each subarea, taken one unit at a time, all possible pairings of groups presented; (4) extent of group agreement when the ranks of importance of each group is compared to the rank of training scores by subareas.

Extent of Group Agreement as Portrayed by the Overall Responses

A study of the grand total ability scores of importance, shown in Table XXI indicates that a high degree of harmony exists between the four groups of respondents relative to the farm-structures area. The data included in this table represent the summary of seventy ability scores, and seven subarea scores, in both importance and training, by major groups of respondents.

The composite array of scores is used as the major basis for comparison, since this compilation represents the responses of all resource persons included in the study, although group-comparisons are made with the training scores, in the last section of the study, as a check. Under the composite heading the total score, 55,220 points, is listed and the next entry in the same column shows 72.4 percent. The latter score is derived as follows:

The highest possible score, for 109 respondents checking seventy items as "essential", at ten points each, is 76,300 points. Then

$$\frac{55,220}{76,300} \times 100 = 72.37 \text{ percent.}$$

This is rounded to the nearest decimal point, or 72.4. Similarly, percentage scores covering the overall farm-structures phase have been computed and are recorded in the same table. The bottom row of figures shows the deviation of each group from the composite scores expressed in percentage points.

The scores of state leaders in teacher education represent the largest deviation, 7.2 percentage points, in the positive direction. Farmers' overall score of 68.5 percent is 3.9 percentage points negative difference, which is the lowest importance rating found among the four groups. Agricultural engineers' score of 79.8 percent represents the smallest difference (negative) of 1.6 percentage points, while the positive 3.1 percentage points deviation of the teacher group is the second nearest to the composite.

The negative deviation of engineers' data paired with the positive deviation of the teacher education group totals 8.8 percentage points, and this difference is found to be statistically significant. The net effect of this difference on the validity of the analysis has not been fully determined, but it is believed to be of minimal importance. Other tests of independence show a similar tendency of these two groups -- one to mark relatively low, the other high, although the trend is more definite in the case of the teacher education group. Farmers' overall score in farm structures is slightly lower than other groups, while teachers' grand total score

of 3.1 percentage points above the composite, represents the "average marking tendency".

TABLE XXI

EXTENT OF AGREEMENT BETWEEN GROUPS OF RESPONDENTS AS REVEALED BY THE GRAND TOTAL SCORES OF IMPORTANCE AND TRAINING COVERING 70 FARM-STRUCTURES ABILITIES

	IMPORTANCE SCORES					TRAINING SCORES
	14 Ag Engrs.	14 Teacher Educ.	39 Teachers	42 Farmers	109 Composite	39 Teacher's Training
Total Score Recorded	6,940	7,800	20,335	20,145	55,220	9,620
Highest Possible Score	9,800	9,800	27,300	29,400	76,300	27,300
Percentage Score	70.8	79.6	74.5	68.5	72.4	35.2
Deviation from the Composite Score	-1.6	+7.2	+2.1	-3.0	0	

Note: This table should be read as follows: (1) the agricultural engineers' total score of 6,940 is 70.8 percent of the highest possible score of 9,800, and their percentage score of 70.8 represents a negative deviation of 1.6 points from the composite score of 72.4

The overall training score is shown as an added means of comparison, although it is recognized that the validity of this method of studying group differences is not very high, since none of the groups being studied participated in the training phase of the investigation, except teachers. Nevertheless, the overall training scores are a part of the total picture, and the pairing of each groups' importance score with the training score reveals that: (1) farmers' total importance percentage is in closest agreement with the training percentage, (2) leaders in teacher education have the score that is farthest from the overall training in percentage points, (3) of the four groups of respondents, agricultural engineers and teachers represent the two groups that are in closest agreement when compared to the overall training score.

It will be noted, again, that the percentage score of the training is computed on the basis of a highest possible score, which includes the unimportant items and the abilities that have never been taught in the farm structures course given for teacher preparation at Michigan State College; consequently, the overall training percentage could not be very high, and it is not used as a measure of overall adequacy of training since it would be misleading.

The distributions of ability scores, by groups, are asymmetrical, the importance curves exhibiting negative skewness while the training curves are skewed in a positive direction. The sigmas of the distributions have been computed, but their value as a measure of variability is limited because of the lack of symmetry in the distribution curves; and their use is further limited by the variability in group size, even though the N's are constant in terms of abilities included. The range in score values in the importance distribution is from 420 to 1,060 points, and the mean is 788 points. Again, the tendency of the distribution to run relatively high is demonstrated by the composite percentage of 72.4; a normal distribution of these scores would cluster around the fifty percent level. These data indicate that the list of abilities submitted was too refined to obtain a normal curve in the scores representing the responses. However, this refinement seemed necessary in view of the length of the list of abilities included in the farm structures investigation.

All things considered, the overall scores of these groups show that the extent of agreement is high and the hypothesis of independence is rejected, except in the case of state leaders in teacher education, whose overall score of importance is significantly different.

Group Relationships As Revealed by the Subarea Scores of Importance

An additional means of assessment of the extent of group agreement is to analyze the order in which the various groups of respondents ranked the seven subareas of abilities, in regard to the importance of each unit in farm structures. The three companion Tables XXII, XXIII, and XXIV, are presented to show: (1) the percentage scores of the subareas, (2) the rank order of the subareas based on percentage, and

TABLE XXII

PERCENTAGE SCORES OF IMPORTANCE AND TRAINING OF 7 SUBAREAS OF FARM-STRUCTURES ABILITIES, BY GROUPS OF RESPONDENTS

Subarea	Number of Abilities in Each	Importance Scores					Training Scores
		Agri. Engrs.	Teacher Educ. Group	Teachers	Farmers	Composite Sample	Teachers
A. General Principles	11	77.3	86.4	75.3	71.4	75.5	42.6
B. Use and Care of Carpentry Tools	9	85.7	90.5	87.2	83.5	86.0	47.6
C. Construction of Farm Buildings	12	72.0	86.9	73.7	64.9	71.8	41.9
D. Related Woodwork	10	52.5	52.8	57.9	57.5	56.5	22.2
E. Painting and Glazing	12	64.6	75.6	71.4	65.7	68.8	24.3
F. Concrete and Masonry	9	75.8	87.7	79.2	69.0	75.9	44.7
G. Repair of Farm Buildings	7	69.9	77.0	81.1	70.6	75.1	21.4

TABLE XXIII

RANKS OF IMPORTANCE AND TRAINING BASED ON PERCENTAGES OF 7 SUBAREAS OF ABILITIES, BY GROUPS OF RESPONDENTS, IN FARM STRUCTURES

Subarea		Rank of Importance					Rank of Training
	Number of Abilities in Each	Agri. Engrs.	Teacher Educ. Group	Teachers	Farmers	Composite Sample	Teachers
A. General Principles	11	2	4	4	2	3	3
B. Use and Care of Carpentry Tools	9	1	1	1	1	1	1
C. Construction of Farm Buildings	12	4	3	5	6	5	4
D. Related Woodwork	10	7	7	7	7	7	6
E. Painting and Glazing	12	6	6	6	5	6	5
F. Concrete and Masonry	9	3	2	3	4	2	2
G. Repair of Farm Buildings	7	5	5	2	3	4	7

Note: Ranks are determined on the basis of the highest to the lowest percentage scores of subareas taken by groups of respondents.

TABLE XXIV

EXTENT OF GROUP AGREEMENT INDICATED BY INTERCORRELATION COEFFICIENTS OF SCORES OF IMPORTANCE AND TRAINING BASED ON SUBAREA RANKS, BY GROUPS OF RESPONDENTS

Respondents By Groups	Importance Values (rho)					Training and Importance
	Agri. Engrs.	Teacher Educ.	Teachers	Farmers	Composite Sample	Teachers' Training
I. Ag. Engrs.		.89**	.75*	.82*	.93**	.86**
II. Teacher Educ.	.89**		.75*	.75*	.89**	.86*
III. Teachers	.74*	.75*		.86*	.89**	.61
IV. Farmers	.82*	.75*	.86*		.86*	.54
V. Composite	.93**	.89**	.89**	.86*		.79*
VI. Teachers' Training	.86*	.86*	.61	.54	.79*	

* Significant at the 5 percent level
** Significant at the 1 percent level

(3) the rho correlation coefficients computed from all possible pairings of groups of respondents. The training ranks are compared to the importance ranks of the different groups as an added measure of group relationship.

The percentages listed in Table XXII show the range of scores covering the entire area of farm structures and these data show that teacher-education personnel tend to rate the subareas of farm-structures abilities higher on the importance scale than other groups, while teachers are second in this respect. Farmers and agricultural engineers seem to be about even in their ratings of the importance of the seven subareas. These data show the range in percentage scores to be 52.5 to 90.5, the former referring to agricultural engineers' rating of D, related woodwork, while the latter rating represents the score of the teacher education group of B, tool care. The differences between the individual groups, by subareas, are seen by comparing each group percentage score with the corresponding composite score which appears in the last column of the table. There is little variability of subarea percentage scores between groups, considering the varied backgrounds of education and experience of the respondents.

The companion Table XXIII indicates the numerical ranks of percentage scores based on the respondent groups' percentage scores. These data show, as an example, the rank order of agricultural engineers' subarea scores in farm structures

2-1-4-7-6-3-5, and these ranks should be read and interpreted as follows: (1) the "2", as the first number in the series, refers to the first subarea on the list of the abilities, that is, A, general principles. The number "2" refers to the place of importance of subarea A, in the whole series of seven subareas, that is, subarea A, is the second largest score in the series. (2) The second number in the series, "1", refers to unit B, tool care, and indicates that this unit ranked first in importance, since the score of that block is the highest in the series. (3) Other numbers in the series should be read and interpreted accordingly.

Table XXIV is the third member of the series of tables on which this phase of the analysis is based, showing the correlation coefficients, derived through the use of the ranks of the percentage scores. The statistic, rho, is a method of measuring the relationship of rank order, sometimes referred to as the rank method of correlation; it is considered to be a valid measure of relationship where the N is small. Rho is particularly valuable for use in computing correlation coefficients of asymmetrical distributions, such as the scores in the present study. The method used to compute the correlation coefficient in Table XXIV is to apply the formula

$$\text{rho} = 1 - \frac{6\,(\Sigma D^2)}{N\,(N^2 - 1)}$$

[1] Henry E. Garrett, Statistics in Psychology and Education, Longmans, Green and Company, New York, 1953. P. 355.

A study of the array of coefficients in Table XXIV shows that all of them are statistically significant at the five percent level and eight of the twenty are significant at the one percent level. Farmers' scores produce the lowest relationships when paired with other groups, although all of the coefficients of the latter are above the five percent level. The coefficients pertaining to agricultural engineers and leaders in teacher education contain two rho's in each instance above the one percent level, while the teachers' list includes one coefficient that is significant at the one percent level. The composite grouping shows the highest relationships when paired with all other groups.

The data presented in this section of the study tend to affirm the earlier presentation showing that a high positive relationship exists between groups, when based on their responses on the importance of the various subareas of abilities in farm structures.

As an added measure of the extent of group agreement (of less importance) each groups' ranks of importance, by subareas, is paired with the ranks of the training, by subareas. The rho's listed in the last column of Table XXIV show the extent of these relationships. These coefficients show that agricultural engineers' and teacher education leaders' ranks of importance, taken by series of subareas, are in agreement with the training ranks, at the five percent level. Likewise, the ranks of subareas of the composite grouping is positively related to the training, that is, the 109 individuals considered collectively are in agreement when their rank order of the subareas on importance is compared to the rank order of the subarea training scores. Teachers' and farmers' ranks are not in complete agreement with respect to the training, as revealed by the coefficients of .61 and .54, neither of which is significant.

The comparisons that appear to have some bearing on the assessment of group differences and similarities are discussed and summarized as follows: (1) agricultural engineers and leaders in teacher education are in harmony with respect to their rank order of importance, compared to the rank order of the training. This relationship is affirmed by the coefficient of .86 for that pairing; (2) farmers' coefficient of .54 indicates that their ratings vary the greatest from the order of training ranks, and although there is some positive relationship indicated, this coefficient is below the 5 percent level; (3) teachers' rank order of importance of subareas, paired with training ranks does not yield a statistically significant rho although it shows a positive relationship; when the whole subarea arrangement of the respondents' ranks of importance is considered the agreement between the importance and the training is fairly high. This is signified by rho .79 -- the composite paired with the training.

Generally high agreement between groups is shown to be prevalent from these comparisons and this fact is in harmony with the data previously presented.

<u>Group Relationships as Revealed by the Ranks of Importance Scores of Abilities within Subareas of the Farm-Structures Area</u>

The extent of specific points of agreement or disagreement between groups of respondents is further indicated by the coefficients of correlation shown in Table XXV. These rho's have been computed by the method used to calculate subarea coefficients with one variation noted as follows: the rank order of abilities in the present method of analysis is determined on the basis of individual scores instead of subarea scores. As an example, the data in Table XXV show that agricultural engineers ranked the abilities in subarea G, repairing farm buildings, as follows; 1-6-3-4.5-7-2-4.5. The first figure listed in the series is "1", indicating that the score of ability number one in this subarea is the highest on the list of seven individual items, while the score of ability number two on the list is in sixth place, according to the magnitude of the scores of each item. Two abilities are tied for rank four, with ninety-five points each, therefore both are given a rank of 4.5, thus there is no rank four or five in this series.

A study of the coefficients listed in Table XXV shows that each respondent group has been paired with all possible

TABLE XXV

INTER-GROUP CORRELATION COEFFICIENTS BY SUBAREAS, BASED ON THE RANKS OF ABILITY SCORES OF IMPORTANCE IN FARM STRUCTURES

AREA Farm Structures	Ag. Engrs. and Farmers	Ag. Engrs. and Teachers	Ag. Engrs. and Teacher Education	Teacher Education and Farmers	Teacher Education and Teachers	Teachers and Farmers
A. General Principles	.40	.25	.00	.01	.81**	.31
B. Tool Care	.73*	.86**	.91**	.66*	.89**	.60
C. Construction	.93**	.94**	.90**	.90**	.94**	.95**
D. Related Woodworking	.74*	.85**	.89**	.45	.60	.86**
E. Painting and Glazing	.75**	.76**	.95**	.66*	.71**	.84**
F. Concrete and Masonry	.57	.89**	.91**	.43	.77*	.62
G. Repair of Buildings	.77*	.87**	.43	.20	.13	.77*

* Five percent level of significance
** One percent level of significance

combinations with other groups, and the resulting coefficients of correlation are presented covering the item ranks of seven subareas in farm-structures.

The training ranks are omitted from this phase of analysis, since they have no logical basis for comparison. The system of pairing used produces six combinations of respondent groups; a coefficient of correlation showing the relationship between each pair is presented, covering the whole range of seven subareas.

A clearer picture of group differences is thus provided, in that the individual ability-scores are used as a measure of harmony and some specific points of differences are uncovered in instances where the overall relationships seem to be in a high state of agreement. As an example of this situation, it is noted from Table XXV that the coefficients in the first row for A, general principles, are unusually low, excluding the teacher education group-teacher pairing, in spite of the high overall agreement between groups as indicated in the preceding tests of group harmony. The extent of this low agreement is noted by the coefficient of the agricultural engineer-teacher education pair which is zero; the teacher education group paired with farmers produces a rho value of .01. Other coefficients in the subarea of general principles are low when the tests are based, as they are here, on the variability of individual item scores.

The data in Table XXV point out several other areas of low agreement as follows: (1) teacher education group-farmers disagree as to the ranks of the individual abilities within four different subareas of farm structures; (2) personnel in teacher education paired with all groups, produce low rho's with respect to the rank of abilities in G, repair of farm buildings; (3) teachers-agricultural engineers-leaders in teacher education, do not agree in regard to B, tool care items; (4) farmers are not in agreement with other groups in G, i.e., repair of buildings. There are several other points of variability which a study of the information in Table XXV will show; however, the data presented in this analysis, on the whole, demonstrate that there is a relatively high degree of harmony between groups with respect to their ranks of the importance of seventy abilities. This fact appears to be substantiated by the following: (1) twenty-eight coefficients are significant at the 5 percent level, and (2) twenty-one of these are also significant at the one percent level. The items, then, that fall below the 5 percent level total fourteen, or one-third of the total. To size up the situation with respect to group variability in scoring individual items, the following points are listed: (1) two-thirds of the total number of rho's are found to be statistically significant; (2) one-third of the coefficients are not significant at the 5 percent level, although most of the latter are positively related; (3) agricultural engineers seem to be in highest positive agreement with other groups; (4) farmers appear to be in the least agreement with other groups; (5) teachers' overall agreement is second in this respect; (6) state leaders in teacher education were third in closest positive agreement with other groups; (7) there is high agreement among all groups regarding the unit construction of farm buildings, as measured by the fact that all rho's are significant at the one percent level; (8) painting and glazing, subarea E, likewise is a point showing high agreement between the groups -- all coefficients falling at or above the one percent level of significance.

A summary of the data presented in this section of the chapter shows that a very high positive relationship exists between groups with respect to the scores covering the overall list of seventy abilities in farm structures, with the exception of the teacher education group. The difference of the overall percentage score of this group, as compared with agricultural engineers is slightly above the level of significance. This fact seems to have a minimal effect on the analysis, although the tendency of these respondents to score the importance higher is a difficult matter to analyze, and receives further treatment in later sections of the study. The data seem to show that the composite of the four groups of respondents represents a homogenous selection of personnel. Some points in variability were shown to exist between groups with respect to the scoring of individual items; however, the extent of the similarities out-weighed the differences.

Subarea, or Unit, Analysis

This section of the study presents the data that relate to the importance and training phases of the farm structures area, considered as subareas, or subject units within the area. The presentation is built around the data which are included in Tables XXII, XXIII, and XXIV, found in the preceding section of this chapter. The principal task of this section is to present the essential facts regarding the relative standing of each of the seven subareas with reference to both importance and training.

In the method used to present group relationships in the preceding section, it was necessary to present many of the data that apply in the present analysis. The nature of this phase of the study requires that some sections of data be presented again in showing the statuses of the subareas in the subject-matter sense. In the former case, the emphasis was on establishment of personal relationships by analyzing the subarea scores, whereas this phase of analysis attempts to show relationships based on the subject-matter units without regard to the personal aspects of the study. Courses given in farm structures usually contain a "unit" in concrete or contain nothing at all in concrete, regardless of the importance that may be attached to a single activity relating to the subject area of concrete.

By referring to Table XXII, it will be seen that subarea B, use and care of tools, is scored high by all groups and that the composite score of 86.0 percent is first, in terms of importance of subareas. The companion Table XXIII shows that this subarea also ranks first in the adequacy of training received by teachers. That the unit tool care is an essential part of the farm structures area is affirmed by the fact that all groups considered it to be the number one item in the area.

Another unit where complete unanimity is present is that of related woodwork which is ranked in seventh position in importance; the training is in close agreement, rank six.

Two subareas are practically tied for rank two in importance. These are general principles, and concrete and masonry; the composite scores of importance are within one percentage point of each other. The final ranks of the training scores of these two subareas are in perfect agreement with the ranks of importance.

By examining the data in Table XXIII one point of discrepancy between the importance and training is found in regard to G, repair of buildings, which is fourth in importance on the composite basis, but the training is ranked seventh, or last.

Subarea construction of farm buildings, is fifth in importance while painting and glazing is sixth. Both of these areas, however, contain some relatively high abilities as will be shown in later analyses.

A review of the data presented in regard to subarea relationships shows that the composite rank order of importance of the seven subareas of abilities, paired with the rank order of the training, is positively related. The relationship, rho .79, is statistically significant at the five percent level, indicating a condition of general agreement between the importance of the units and the adequacy of training received. However, as the same section of the study indicates, the rank order of teachers and farmers, although positively related, was not significant at the five percent level.

On the basis of the overall percentage scores the seven subareas in farm structures are listed in the decending order; both importance and training scores are shown in the following lists:

Subarea	Percent	Subarea	Percent
1. Use and care of tools	86.0	1. Use and care of tools	47.6
2. Concrete and masonry	75.9	2. Concrete and masonry	44.7
3. General principles	75.5	3. General principles	42.6
4. Repair of farm buildings	75.1	4. Construction of farm buildings	41.9
5. Construction of buildings	71.8	5. Painting and glazing	24.3

6. Painting and glazing	68.8	6. Related wood work	22.2
7. Related wood work	56.5	7. Repair of farm buildings	21.4

The largest discrepancy with respect to the training ranks compared to the importance ranks is the repair of farm structures, which is ranked seven in training, is ranked fourth in importance; this is three ranks out of order. Otherwise, the training is not out of agreement by more than one rank order. The percentage of the subareas in regard to training scores run considerably lower than the importance; however, the statistical limitations involved in the use of these scores in evaluating the absolute adequacy of the training have been discussed. The only defensible statement possible in summarizing the data relative to training scores of the subareas is that the difference in percentage levels of the importance on the one hand, the the training on the other, is quite large.

Item Analysis

The major task of this phase of the study is to make an assessment of the relative standing of each of the seventy abilities, within the seven subareas of farm structures. The status of the importance and the training are presented, and the extent of the agreement existing between these two variables is presented through the application of statistical analyses of several types.

The following techniques are used to present the data relating to farm-structures abilities as individual items: (1) the overall agreement between the importance and training distributions taken as a whole, and (a) variabilities of individual items within subareas taken one subarea at a time; (2) the status of each of seventy farm structures abilities presented through the use of a scatter diagram showing (a) importance level or interval, (b) training level, (c) extent of agreement as determined by the importance and training levels of each ability, and (d) digest of changes suggested and indicated in training emphasis in the three highest score levels on both scales; (3) an itemized statement including seventy abilities, by name, and designating the importance, training, and agreement statuses of each item (a) a digest of selected factors relative to the item analysis. Each main sub-topic is summarized separately.

A Comparison of the Training and Importance of Seventy Farm Structures Abilities with Respect to Overall Agreement

The agreement between the importance and training scores of the subareas, as well as items, has been touched upon in previous analyses. This phase of the investigation compares the entire distributions of the importance and training scores to determine the extent of overall agreement. The Pearson correlation method is used to test this relationship and the coefficient is .643. When N is seventy, as it is in this instance, the test for statistical significance is .30 at the one percent level. Since r = .643, it can be seen that the overall agreement between the training and importance is quite high. The high positive relationship existing in this overall test is suggestive of general agreement throughout most of the several aspects of the investigation. It remains to be seen whether there are smaller areas or "spots" of disagreement between the training and the importance as the next phase of the analysis attempts to show.

Some of the essential characteristics of the two frequency distributions are shown in Table XXVI. The general trends in both cases are found to be toward asymmetrical curves -- the importance frequency showing negative skewness, the training frequency showing positive skewness.

The seventy scores of importance range from 420 to 1,060 points and are designated as the x-variable. The training scores range from 30 to 280 points and this scale represents the y-variable. The mean of the x-distribution is 793.78, while the y-mean is 138.07, as calculated by the use of a correlation table. The sigma of the importance distribution is 149, while the sigma of the training distribution is 66.40. These latter two measures of variability are not directly comparable, due to the difference in the size of the groups involved.

TABLE XXVI

CHARACTERISTICS OF THE DISTRIBUTIONS OF TRAINING AND IMPORTANCE SCORES OF 70 ABILITIES IN FARM STRUCTURES

Characteristic of Measure	X-Variable (Importance)	Y-Variable (Training)
Range in Scores	420 - 1060	30 - 280
Mean of Distribution	793.78	138.07
Sigma of Distribution	149	60.40
r equals .643		
1 percent level equals .30		

TABLE XXVII

CORRELATION COEFFICIENTS OF THE RANKS OF ITEMS IN THE TRAINING PAIRED WITH ITEMS IN THE COMPOSITE, TAKEN BY SUBAREAS

Subarea	Rho
A. General Principles	.44
B. Use and Care of Tools	.78*
C. Construction of Buildings	.86**
D. Related Woodworking	.71*
E. Painting and Glazing	.62*
F. Concrete and Masonry	.14
G. Repair of Farm Buildings	.49
* 5 percent level	
** 1 percent level	

The importance scores, on the whole, run higher than would be expected in a normal distribution. The training scores run somewhat lower than would be expected in a normal distribution. The area that ranks highest in training is tool care with an average importance score of 46.6 points; it compares unfavorably with the composite of importance in tool care, which has been scored at 86.0 points. The statistical basis for evaluating the level of the training scores is not defensible, but the high disagreement between the two scores raises some question in regard to the general training level, if these scores were to be considered as valid. The data presented in this section indicate that a high degree of positive relationship between the training and importance scores exist on the overall basis, but the method used in the study is not considered as a valid means of evaluating the score levels of any given ability or subarea as an absolute measure.

Table XXVII includes correlation coefficients, rho, computed from the ranks of individual abilities, taken one subarea at a time, and training item ranks are paired with the item ranks in the composite importance distribution. The correlation coefficients in Table XXVII show that the least agreement is found in the subarea concrete and masonry, which has a rho of .14, while i.e., repairing farm buildings has a recorded rho of .49, which is not statistically significant, although the coefficient does indicate positive relationship. Similarly, the coefficient .44 of general principles, is not significant at the 5 percent level.

The coefficients of the other four subareas are positively related at the 5 percent level when the training ranks of individual items are paired with the importance ranks. The coefficients in Table XXVII show that three specific points of difference exist, even though the overall agreement is high.

The data presented in this section show that: (1) the Pearson correlation coefficient between the overall distribution of seventy training scores paired with importance scores of seventy abilities in farm structures is .643, which indicates a high positive relationship when N is seventy; (2) the importance scores are exceptionally high, based on what would be a normal distribution; (3) the training scores are lower than the importance scores, though the overall "drift" indicates high positive relationship between importance and training; (4) the highest training was found in the unit of tool care, and the scores of that subarea averaged approximately 55 percent of the importance scores of tool care; (5) coefficients of correlation based on the individual ranks within subareas show lower agreement in concrete and masonry, repair of farm buildings, and general principles, but the other units in farm structures appear to be in agreement to a high degree.

Scatter Diagram Analysis of Importance, Training, and Extent of Agreement of 70 Abilities in Farm Structures

One of the major purposes of the investigation is to determine the status of each ability in the study with respect to the relative importance, adequacy of training received, and the extent of the agreement existing.

This section shows the relative standing of each of seventy abilities as individual items, but also portrays each as a part of the total picture. The method of presentation is designed so as to reveal three relationships in a single diagram, namely: (1) the importance interval of each ability score as determined by its position on a uniform scale of percentages; (2) the training interval of each ability score as determined by its position on a uniform scale of percentages; (3) the extent of agreement existing between the importance and training intervals of each ability in relation to its position on both scales. Figure 7 has been constructed by taking the importance distribution as the x-variable and the training distribution as the y-variable.

Figure 7 shows a type of scatter diagram that resembles the correlation table in form, but is different in one principal respect namely, the numbers of items are uniformly scaled in the present figure, whereas the correlation table is constructed on the basis of uniform score-scale. The purpose of the technique used in the present analysis is to

Fig. 7. Scatter diagram of 70 farm structures abilities

X-Importance Scores

Y-Training Scores	420-685	690-790	795-845	850-885	890-1060	N
205-280	O	D4 O	A6,A8 C2, F2,F5 O	A5, F1 S	B2,B3,B8,B9 C1, C7 H	14
165-200	O	C3, F3,F8 O	S	A3,A4,A7 B1, C5,C6 F4,F7 H	B5,B7 C4, D10 S	15
115-160	O	A10, C8,C9, D1, E10 S	E1, E4, G7 H	E3,E5 S	A1, A2, B4 U	13
70-110	A9, C10,C11, D2, E2 S	A-11, B6 H	F6, G4 S	G1,G6 U	E12 U	12
30-65	C12 D5,D6,D7,D8 D9,D3 E7,E11 H	E6,E9 F9, G5 S	E8, G2,G3 U	U	U	16
N	14	15	13	14	14	

LEGEND

1. Combination letters-numbers refer to the symbols of abilities.
2. "H" refers to high agreement.
3. "S" refers to satisfactory agreement.
4. "O" refers to overemphasis of training.
5. "U" refers to underemphasis of training.

show the relation between different percentage levels of importance compared to the same percentage levels on the training axis.

By examining the diagram in Figure 7 it will be seen that it contains twenty-five cells arranged in five columns and five rows, the columns representing various intervals of importance of the distribution by quintile division, and the rows representing the five intervals of training scores in the distribution by quintile division.

The method of scaling consisted of dividing each of the two frequency distributions into five units of approximately 20 percent. This method of division produced intervals of approximately fourteen scores each. Cutting points were determined by calculating the first, second, third, and fourth quintiles, then followed several minor adjustments which were necessary in order to place all equal scores in the same interval. Step-intervals then, were established on each axis so as to include: (1) the first step interval, of fourteen importance scores below the first quintile, or 420 through 685 points, (2) the second interval, of fifteen importance scores above the first and below the second quintile, or 690 through 790 points, etc. The y-scale was constructed in a similar way, using the training scores and making adjustments so as to include equal scores in the same step interval.

When the diagram was completed, each ability was plotted in its proper cell with respect to its importance and training scores; as an example, the first ability on the list, coded A-1, refers to the first ability listed in subarea A; this item has an importance score of 900 points and a training score of 140 points. By reading along the x-axis it will be noted that this score belongs in the fifth, or highest interval of importance. Reading up the y-axis the correct step interval of the training score is found in the third row from the bottom; hence the symbol A-1, is entered in column five, row three. In a similar manner, the entire list of abilities are plotted on the scatter diagram.

This structure provides a method of determining the status of any ability on the list by noting the location of the item in the diagram in relation to both importance and training axes. In addition to these two measures, the extent of agreement between the importance and training can also be determined; as an example, reading in the fifth row from the left, the second cell from the bottom contains the symbol E12. By checking the master list of abilities in the next section of this chapter, it will be found that E12 refers to selecting and applying metal paint to farm machinery. Some interpretations that can be determined from the position of E12 on the diagram are: (1) this ability has an importance score falling in the fifth interval and the training score falls in the second interval; (3) since the training interval is three and the importance interval is five, the extent of agreement is labeled as "underemphasis" of the training and is marked "u".

By examining the diagram further, it will be noted that the extent of agreement is classified in four ways, namely,

1. <u>High agreement</u>: High agreement is defined as being the relationship between the training and importance intervals of a given ability existing when these intervals are the same, that is 5-5 or 4-4. The abilities representing high agreement between the two variables will be found in the diagonal row of five cells running from the upper right-hand corner to the lower left in the diagram. The symbol "H" is used to designate this relationship.

2. <u>Satisfactory agreement</u>: A relationship that exists when the training and importance intervals of a given ability lie in adjacent positions on the scale, either above or below, <u>viz</u>., training 5 -- importance 4, or the relationship might be reversed. There are eight cells so classified and the letter "S" signifies this relationship.

3. <u>Overemphasis of training</u>: An ability having a training score that falls on the scale at least one full interval above its importance interval represents the relationship referred to as "overemphasis", as an example, training 5 -- importance 3. The six cells clustered in the upper left-hand corner of the diagram represent this area, referred to as "O".

4. <u>Underemphasis of the training</u>: An ability having a training score that falls on the scale at least one full interval below its importance interval is considered to represent "underemphasis" in terms of the training. The six cells which cluster in the lower right hand corner of the diagram comprise this area, and the symbol used to designate undertraining is "U".

A study of the scatter diagram, Figure 7, reveals the following facts:

1. The two highest intervals of the importance scores contain abilities from the following subareas:

A.	General principles	6 abilities
B.	Tool care and use	8 abilities
C.	Construction of buildings	5 abilities
D.	Related woodwork	1 ability
E.	Painting and glazing	3 abilities
F.	Concrete and masonry	3 abilities
G.	Repair of buildings	2 abilities

2. The lowest interval of importance scores contain items from subareas as follows:

A.	General principles	1 ability
C.	Construction of buildings	3 abilities
D.	Related woodwork	7 abilities
E.	Painting and glazing	3 abilities

3. The two highest intervals of training scores contain abilities from subareas as follows:

A.	General principles	6 abilities
B.	Tool care and use	7 abilities
C.	Construction of buildings	7 abilities
D.	Related woodwork	2 abilities
F.	Concrete and masonry	7 abilities

4. The lowest training interval contains fourteen abilities, distributed as follows:

C.	Construction of buildings	1 ability
D.	Related woodwork	6 abilities
E.	Painting and glazing	5 abilities
F.	Concrete and masonry	1 ability
G.	Repair of buildings	3 abilities

5. The five cells representing high agreement contain twenty-eight abilities, nine of which are located in the lowest interval of importance, and may be discounted to some extent in assessing the agreement between training and importance. Nevertheless, the nine lowest scores belong in the seventy items in the study, and the twenty-eight scores classified as high in agreement represent 40 percent of the total number. The item statement follows in the next section, where the agreement by individual abilities may be checked. The abilities are identified by name in that section.

6. Of the cells representing the "overemphasis" area in the diagram, three cells contain nine abilities, or 12.8 percent of the total, while three other cells are vacant.

7. The "underemphasis" area contains nine items also, or 12.8 percent of the total, and two cells in that section of the diagram are vacant.

8. The "satisfactory" area contains twenty abilities, or 34.3 percent of the distribution.

The information presented in connection with the scatter diagram constructed from an x-variable of importance scores and a y-variable of training scores, revealed the following essential facts in regard to farm structures abilities:

1. A majority of the abilities included in the upper 40 percent of the <u>importance scores</u> came from the subareas tool care and use, general principles, and construction of buildings, while the largest block of abilities found in the lowest interval of importance belong in the subarea of related woodwork.

2. The upper 40 percent of the <u>training scores</u> are the units tool care and use, construction of buildings, concrete and masonry and general principles.

3. The lowest interval in importance includes items mostly from related woodwork, construction of buildings, and painting.

4. The lowest interval of training scores contains abilities mostly from related woodwork, painting and glazing, and repair of buildings.

5. The high agreement area contains twenty-eight abilities, or 40 percent of the total number included in the farm structures area.

6. The over and underemphasis areas of training each contain nine abilities, or 12.8 percent of the total distribution.

7. The satisfactory agreement area contains twenty-four abilities or 34.3 percent of the total.

Digest of Data Relative to Some Changes Indicated in the Training Emphasis of Farm Mechanics Abilities

This phase of the investigation represents an outgrowth of the preceding section of the study, and is complementary to it. The purpose of the present analysis is to assess the extent of the changes in the training emphasis that seem to be indicated by the data in the scatter diagram, Figure 7. Two types of analyses are represented by Tables XXVIII and XXIX; the first relating to the definite changes indicated, are supported by the statistical criterion of at least one full step-interval of buffer zone between the importance and training intervals of a given ability; the second, referring to the fringe-area changes or suggestions to be studied, are

TABLE XXVIII

CHANGES INDICATED IN THE TRAINING EMPHASIS IN THE THREE HIGHEST LEVELS*

IN THE FARM-STRUCTURES DISTRIBUTIONS

Interval	Abilities Listed by Intervals in the Importance Distribution, Showing Changes Indicated		Abilities Listed by Intervals in the Training Distribution, Showing Changes Indicated	
	Increase Training	Decrease Training	Increase Training	Decrease Training
5				
Range in Training Scores 205 - 280; Range in Importance Scores 890 - 1060	A-1, A2 B4 E12	None	None	A6, A8 C2 D4 F2, F5
4				
Range in Training Scores 165 - 200; Range in Importance Scores 850 - 885	G1, G6	None	None	C3 F3, F8
3				
Range in Training Scores 115 - 160; Range in Importance Scores 795 - 845	E8 G2, G3	A6, A8 C2 F2, F5	A-1, A2 B4	
Totals	9	5	3	9

* Level refers to intervals as illustrated in the scatter diagram of Fig. 7.

not supported on a statistical basis. These latter changes are suggested for further study as a possible means of obtaining small increments of improvement in the overall harmony between the importance and training, as may appear feasible in the case of any given ability. It is entirely possible that recent shifts in the organization of course content, and/or recent changes in the emphasis of the instruction in the structures area would nullify these suggestions.

On the other hand, it is quite possible that the two scores of a given ability could be in adjacent intervals, as importance 4 -- training 5, yet may vary almost two full intervals. It is for the protection of the investigation, obviously, that establishment and use of a statistical criterion is applied in assessing the changes that seem to be needed in the instruction. The definite training changes are presented, therefore, with a little more confidence, although it is possible that recent shifts in the farm-structures training may have occurred and would thus serve to nullify some or all of these changes, also.

Definite changes indicated in the training emphasis. The method used to organize and present the data included in Tables XXVIII and XXIX involved some duplication in enumerating the abilities found in each score interval, since the training and importance bands cross each other in the diagra. Another type of duplication encountered in the present type of analysis is referred to as "reciprocal effect"; as an example, changes that are recorded in checking the fifth interval of importance are recorded again in the analysis of changes occurring in a lower level of the training distribution. In order to avoid distortion of the percentages, the population is counted so as to include all of the abilities in both training and importance intervals on the diagram, that is, each band of training is considered as a separate unit, while each level of importance is treated likewise.

Column one in Table XXVIII includes descriptive data relative to the three step-intervals of importance and training scores as shown in the scatter diagram, Figure 7. Column two contains data extracted from the three highest levels of importance scores, expressed as abilities needing changes in the training emphasis, while column three contains similar data extracted from the three highest levels of the training. It can be noted by referring to Table XXVIII that each of columns two and three include sub-columns of increases and decreases. By studying the diagram in Figure 7 the procedure followed in assessing these changes is found to be relatively simple; to illustrate, the five cells comprising the fifth level of importance contain fourteen farm structures abilities, four of which are located in two cells of the interval designated as a zone of underemphasis of the training. These four abilities have been entered in column one under the subheading of "increase the training".

By following a similar procedure, the three highest levels of importance and training have been checked; abilities lying in all of those levels have been identified as to the status of agreement existing; the abilities have been entered as increases and/or decreases in the training.

The areas representing the most critical changes that seem to be needed are assumed to be the highest intervals in both variables and a study of Table XXVIII reveals that the major items are as follows:

The increases that are indicated in the three highest intervals of importance are (a) four abilities lying in the fifth step interval, (b) two abilities located in the fourth interval, and (c) three abilities found in the third level.

There are no decreases indicated in the fourth or fifth intervals of importance; however, five items are found in the "decrease training" sub-column of the third level of importance.

The description of these abilities, relative to the subarea and general nature of each item, is summed up as follows: (a) increase the emphasis in teaching A-1, planning farm structures according to sound principles of economics, and A2, planning structures to meet the functional requirements of various agricultural enterprises; (b) additional training seems to be needed in selecting and purchasing power wood working equipment; (c) an increase appears in order in the teaching of painting farm implements with metal paint, E12; (d) the data indicate that some increases in the instruction is indicated in: G1, determining need for and cost of repairs of farm buildings; G6, repairing fences and gates; G2, repairing foundations; and G3, repairing roofs; the ability E8, treating lumber with preservatives, also appeared to be in need of increased instruction.

The decreases suggested for abilities lying in the third band of importance are covered by the reciprocal effect of changes indicated in the fifth level of training, and the detailed description of these items follows under that section.

A further study of Table XXVIII reveals that the three top intervals of the training distribution include: (a) six decreases of the training emphasis in the fifth level; (b) (b) three decreases in the fourth level; and (c) three increases in the third level. A study of the nature of the abilities involved in these changes shows that the following types of activities are involved: (a) decreases in the emphasis of the instruction of A6, reading blueprints, and in A8, preparing a bill of material; (b) decreases also were signified in C2, driving nails, in C3, using wood connectors, and in D4, drilling holes in lumber; (c) the abilities F2, F3, F5, and F8, all relating to concrete and masonry, fell into the decrease classification, and these items involved (1) selecting aggregates for making concrete, (2) selecting concrete masonry blocks, (3) mixing, placing and finishing concrete, and (3) laying concrete blocks.

Three other abilities, located in the third level of training, were covered by the reciprocal effect of the fifth band of importance scores.

The data presented in the foregoing analysis showed that:

1. Twelve abilities in the top three levels needed some increase in teaching emphasis, representing 14.4 percent of the total population of both importance and training.

2. Total decreases were indicated for fourteen abilities, amounting to 16.8 percent of the totals involved.

3. The total changes involving both increases and decreases in the three highest levels of both variables, thus represented 31.3 percent of the entire populations.

<u>Fringe-area changes suggested for further study</u>. Previous explanation has been made relative to the nature of the changes included in Table XXIX. By checking the scatter diagram in Figure 7, it can be determined that the abilities possessing the relationship dealt with in the present analysis lie in the two zones labeled "satisfactory"; moreover, the interval values of the abilities included will be noted as "importance 5 -- training 4" and the like, or the relationship may be reversed, as "importance 4 -- training 5". It will be noted, also, that these data are presented as suggestions for possible shifts in instructional emphasis -- not as definite changes.

TABLE XXIX

FRINGE-AREA CHANGES SUGGESTED IN THE TRAINING EMPHASIS IN THE THREE HIGHEST LEVELS IN THE FARM-STRUCTURES DISTRIBUTIONS

Interval	Abilities Listed by Intervals in the Importance Distribution, Showing Nature of Change Suggested by the Data		Abilities Listed by Intervals in the Training Distribution, Showing Nature of Change Suggested by the Data	
	Increase Training	Decrease Training	Increase Training	Decrease Training
5				
Range in Training Scores 205 - 280 Range in Importance Scores 890 - 1060	B5, B7 C4 D10	None	None	A5 F1
4				
Range in Training Scores 165 - 200 Range in Importance Scores 850 - 885	E3, E5	A5 F1	B5, B7 C4 D10	None
3				
Range in Training Scores 115 - 160 Range in Importance Scores 795 - 845	F6 G4	None	E3, E5	A10 C8, C9 D1 D10
Totals	8	2	6	7

The suggested changes included in the three highest bands of importance include a total of eight increases and two decreases; the three highest intervals of the training scores include six increases and seven decreases.

The nature of the items appearing in Table XXIX, column one, are as follows:

The abilities B5 and B7, falling in the increase-of-training zone, involve operating woodworking equipment, and storing woodworking tools correctly, while C4, laying out a foundation site, also was suggestive of some increase in teaching; D10, the construction of ordinary wood projects, seemed to need further study for possible increase in emphasis. E3, preparing surfaces for painting, and E5, storing paint brushes, were two other abilities listed as being suggestive of increases in the training; F6, selecting and applying masonry paint, tended to show needs of increase in the instruction. One ability in the repair unit was located in the area of suggested increase in training, viz., G4, repairing windows and doors.

The decreases suggested in the importance aspect are covered by reciprocal effect of a higher level in the training distribution.

The six increases that are suggested in the upper three intervals of the training distribution have been covered by the reciprocal effect of the fourth and fifth levels of importance.

The fringe-area decreases that need further study relate to the following kind of activities: the ability A5, making simple drawings, is found in the zone that is suggestive of a decrease in training emphasis; A10, designing ventilation and insulation plans, also falls in the decrease-of-training zone; cutting and applying roofing, C8, and cutting and applying sheathing, C9, are found in the area that is suggestive of decreases; the ability D1, constructing wood joints, is in the area which suggests a decrease in the training emphasis, while cutting and installing glass, E10, also falls in this zone. The ability F1, estimating quantities and costs of concrete and masonry materials, was located in the area which was suggestive of a slight decrease in the instruction.

(1) The data presented in the foregoing analysis revealed that that the upper three levels of importance and training in the fringe area, together, contained a total of fourteen abilities that were suggestive of increases in the training emphasis; on the basis of a population consisting of eighty-three scores the suggested changes, as cited, above represented 16.8 percent of the total number; (2) there was a total of nine abilities in the three highest levels of both variables lying in the zones that were suggestive of decreases in the teaching emphasis; these suggested changes represent 10.8 percent of the total population of eighty-three ability scores.

(3) the combined fringe area suggestions for changes in the training totaled twenty-three such instances, representing 27.6 percent of the population.

A review of the changes in instructional emphasis and suggestions for study shows that the total of the definite changes and the fringe area suggestions is (1) twenty-six increases representing 31.3 percent of the population; (2) twenty-three decreases in emphasis representing 27.7 percent of the total; (3) the grand total of the increases and decreases included forty-nine abilities in both types of analysis. The total of both presentations, thus, involved approximately 59 percent of the population of the cases studied in both variables. The limitations of this type of analysis included the absence of a statistical criterion in the case of the suggested changes; the chance that the instructional emphasis may have changed since the respondents doing the checking were in college is present also.

Itemized Statement of the Three Statuses of Seventy Abilities in Farm Structures

This section of the investigation presents an itemized statement of each ability relative to the three statuses that seem to be of greatest value in the item analysis, namely, (1) the importance interval expressed in terms of the position on the distribution scale, (2) the training interval expressed in terms of the position on the distribution

TABLE XXX

ITEMIZED STATEMENT OF 70 FARM-STRUCTURES ABILITIES RELATIVE TO THE IMPORTANCE, TRAINING AND EXTENT OF AGREEMENT

Abilities Included in This Area	Final Standing of Each Ability in Regard to:		
	Importance Interval*	Training Interval*	Extent of Agreement**
A. General Principles -- Ability to:			
1. Plan farm structures according to sound principles of economics.	5	3	U
2. Plan structures according to functional requirements of various agricultural enterprises.	5	3	U
3. Estimate size, capacity and cost of farm structures.	4	4	H
4. Select most desirable building materials.	4	4	H
5. Make simple drawings of farm structures.	4	5	S
6. Read and interpret blueprints.	3	5	O
7. Plan the location of buildings in relation to the farmstead.	4	4	H
8. Prepare a standard bill of materials.	3	5	O
9. Design or select joists and beams for strength.	1	2	S
10. Design the insulation and ventilation plans for structures according to requirements of various agricultural enterprises.	2	3	S
11. Locate and use Building Manufacturers "Plans Services".	2	2	H
1. Select and purchase carpentry tools according to accepted standards.	4	4	H
2. Use basic carpentry tools correctly.	5	5	H
3. Sharpen, adjust, maintain, and repair carpentry tools.	5	5	H
4. Select and purchase power woodworking equipment for the school and farm shop.	5	3	U

* 1,2,3,4,5 under "importance" and "training" intervals refer to position on scale of scatter diagram, Fig. 7.

** "H" refers to high agreement, "S" refers to Satisfactory agreement, O refers to overemphasis, U refers to underemphasis, as determined by the position of the ability on diagram, Fig. 7.

TABLE XXX (Cont.)

Abilities Included in This Area	Final Standing of each Ability in Regard to: Importance Interval*	Training Interval*	Extent of Agreement**
5. Operate power woodworking equipment correctly.	5	4	S
6. Maintain and repair power woodworking equipment.	2	2	H
7. Store carpentry tools effectively.	5	4	S
8. Place shop equipment in best location for safety and effeciency.	5	5	H
9. Apply principles of safety in the use of tools and power equipment.	5	5	H
C. Construction of Farm Buildings -- Ability to:			
1. Measure, mark and cut materials to specified dimensions.	5	5	H
2. Drive various kinds of nails.	3	5	O
3. Use wood connectors and fasteners.	2	4	O
4. Lay out foundation lines and set grade stakes for buildings.	5	4	S
5. Place or pour footings for various structures.	4	4	H
6. Calculate dimensions, cut, and erect framing.	4	4	H
7. Calculate dimensions, cut, and erect common rafters.	5	5	H
8. Apply roofing.	2	3	S
9. Cut and apply sheathing and siding.	2	3	S
10. Cut and install insulation material.	1	2	S
11. Calculate dimensions, construct, and erect stairways.	1	2	S
12. Cut and apply material for interior and exterior walls.	1	1	H
D. Related Woodworking -- Ability to:			
1. Construct common wood joists.	2	3	S
2. Select and use wood glue.	1	2	S
3. Use wood dowels.	1	1	H
4. Drill holes in lumber.	2	5	O
5. Construct kitchen cabinets.	1	1	H
6. Make small articles of furniture.	1	1	H
7. Repair furniture.	1	1	H
8. Install door locks.	1	1	H
9. Cut and install linoleum, and floor tile.	1	1	H

TABLE XXX (Cont.)

Abilities Included in This Area	Final Standing of each Ability in Regard to: Importance Interval*	Training Interval*	Extent of Agreement**
10. Construct ordinary wood projects for farm use, i.e., trailer box, feed bunker, poultry feeder, etc.	5	4	S
E. Painting and Glazing -- Ability to:			
1. Select house paint and other wood finishes according to requirements.	3	3	H
2. Mix and/or tint paint according to requirements.	1	2	S
3. Prepare surfaces for painting.	4	3	S
4. Select proper paint brushes and apply paint, varnish, shellac, and enamel.	3	3	H
5. Clean and store paint brushes.	4	3	S
6. Apply paint with paint sprayer.	2	1	S
7. Select, mix, and apply wood stains.	1	1	H
8. Treat lumber with preservatives.	3	1	U
9. Select and apply proper masonry paint.	2	1	S
10. Measure, cut, and install glass.	2	3	S
11. Refinish furniture.	1	1	H
12. Select and apply metal paint to farm machinery, roofing, etc.	5	2	U
F. Concrete and Masonry -- Ability to:			
1. Estimate quantities and costs of concrete and masonry materials needed for a given structure.	4	5	S
2. Select aggregates for making concrete and test for quality.	3	5	O
3. Select masonry blocks and determine quality.	2	4	O
4. Construct forms needed in building various concrete structures common to the farm.	4	4	H
5. Mix, place, and finish concrete.	3	5	O
6. Select and apply paint, coloring, and waterproofing materials to concrete and masonry.	3	2	S

TABLE XXX (Cont.)

Abilities Included in This Area	Final Standing of Each Ability in Regard to:		
	Importance Interval*	Training Interval*	Extent of Agreement**
7. Prepare mortar for concrete masonry.	4	4	H
8. Lay concrete masonry according to standards of construction.	2	4	O
9. Repair or patch broken concrete.	2	1	S
G. Repair of Farm Structures -- Ability to:			
1. Determine need for repairs and estimate costs of given job.	4	2	U
2. Repair foundations.	3	1	U
3. Repair roofs.	3	1	U
4. Repair windows and doors.	3	2	S
5. Repair floors.	2	1	S
6. Repair fences and gates.	4	2	U
7. Repair farm equipment made of wood.	3	3	H

scale, and (3) the extent of agreement existing between the importance and training intervals for a given ability expressed in terms of four gradations as follows: overemphasis, underemphasis, high, and satisfactory.

A study of the method of organization of Table XXX will show that the list of 70 abilities has been retained as it appeared in the original farm-structures instrument, and the abilities are still considered as items belonging in or included in the seven subareas, although the status of the individual items is given the greatest emphasis in the presentation. This section of the investigation is considered to be complementary to the analysis by scatter diagram. Table XXX presents data that have been extracted from Figure 7. Three columns of symbols provide the appropriate keys by which the status of each ability can be interpreted and described.

The status of each of the seventy abilities included in this list may be found by checking the list of items included in Table XXX.

Digest of Selected Factors Relative to the Item Analysis in Farm Structures

The digest of selected factors relating to the item-analysis is based on the data included in Table XXX. The presentation of these factors as revealed by the data in Table XXXI shows: (1) the number of abilities included in each of the five intervals on the importance and training

TABLE XXXI

COMPARISON OF TRAINING AND IMPORTANCE STATUS OF ABILITIES IN THE FIVE LEVELS OF THE DISTRIBUTIONS IN FARM STRUCTURES

Subarea	Number of Abilities in Each Subarea	Number of Abilities Occurring in Each Interval, by Subarea										Total no. of Abilities in Three Highest Intervals		Rank of Subareas	
		5th		4th		3rd		2nd		1st					
		Imp.	Trn.	Imp.	Trn.	Imp.	Trn.	Imp.	Trn.	Imp.	Trn.	Imp.	Trn.	Imp.	Trn.
A. General Principles	11	2	3	4	3	2	3	2	2	1	0	8	9	1.5	1.5
B. Use and Care of Tools	9	7	4	1	3	0	1	1	1	0	0	8	8	1.5	3
C. Construction of Buildings	12	3	3	2	4	1	2	3	2	3	1	6	9	4.5	1.5
D. Related Woodwork	10	1	1	0	1	0	1	2	1	7	6	1	3	7	6
E. Painting and Glaz.	12	1	0	2	0	3	4	3	2	3	5	6	5	4.5	5
F. Concrete and Masonry	9	0	3	3	4	3	0	3	1	0	1	6	7	4.5	4
G. Repair of Structures	7	0	0	2	0	4	1	1	3	0	3	6	1	4.5	7
Totals	70	14	14	14	15	13	13	15	12	14	16	41	42		

scales, by subareas; (2) the total number of abilities found in the three highest levels of importance and training, presented by subareas; (3) rank order of importance and training shown on the basis of the three highest levels, and these data are classified by subareas. Table XXXII shows additional data relative to: (1) the number of abilities in each subarea classified by types as to managerial, manipulative, and combination; (2) total number of abilities in the farm structures area classified by types; (3) the average score levels of each type of ability, by importance and training distributions.

By examining the data on which Table XXXI is based it can be noted that eight of the eleven abilities in subarea A fall into the highest three levels, and at the same time, nine abilities from subarea A received training scores that fall in the three highest levels. Similarly, eight of the nine items in subarea B, are located in the highest levels of importance, while eight abilities in the same subarea received training scores in the highest three levels.

One-half of the abilities in construction of farm buildings are found in the three highest levels of importance, while three-fourths of the training scores fall into the highest brackets in the construction unit. Only one item in related wood work appears in the three highest importance levels, while one-half of the painting and glazing items are found there, and six of the nine are thus classified in concrete and masonry. Six of the seven items in repairing farm structures are included in the three highest levels, but only one ability has a training score that high in the same subarea.

By a similar process, the low brackets of the importance and training scales may be assessed for any subarea. The ranks, based on the three highest levels of training and importance, are shown in a slightly different light than when the entire distribution was considered, although both the tool processes and general principles are still in first place with tied scores. The ranks of the training scores, on the present basis, is shown in a less favorable light than in the previous analysis that was based on the total distribution.

The distribution of abilities, by types, is shown in Table XXXII, and the data indicate that one-half of the managerial type of abilities are found in one unit, namely general principles, which contains seven of the total number. Three abilities in the tool care subarea are classifed as managerial, and two others appear in the painting unit. Concrete and masonry and repairing buildings each contain one managerial item.

Three subareas, collectively, contain over one-half of the manipulative-type of abilities, namely, construction, painting and glazing, and related wood work. The data in

TABLE XXXII

NUMBER OF ABILITIES IN EACH SUBAREA, BY TYPES AND SCORE LEVEL*

Subarea	Number of Managerial Type	Number of Manipulative Type	Number of Combination Type
A. General Principles	7	3	1
B. Use and Care of Tools	3	4	2
C. Construction of Farm Buildings	0	9	3
D. Related Woodwork	0	10	0
E. Painting and Glazing	2	9	1
F. Concrete and Masonry	1	6	2
G. Repair of Farm Structures	1	6	0
Totals	14	47	9

	Score Levels	
	Importance	Training
Average score level of 14 managerial abilities	3.6	3.3
Average score level of 47 manipulative abilities	2.6	2.8
Average score level of 9 combination abilities	3.8	3.9
Average score level of 70 abilities	3.0	3.0

* Score level refers to score intervals as defined in Fig. 7.

Table XXXII show that these three subareas contain only two managerial abilities.

The nine combination-type of abilities are distributed among five subareas.

The interval score levels of the three types of abilities reveal some overall differences when each group average is composed. It can be noted from the data in Table XXXII that the combination type is highest on the scale, with an average level of 3.8 in importance, while the manipulative type is lowest with an average of 2.6. The average score level of the fourteen managerial abilities is 3.6.

The average level of the total distribution, in training and importance is 3.0. Compared to that level, the managerial group averages somewhat above the distribution level, while the operative group is lower. The combination type falls above the distribution level also.

This section of the investigation presented the seventy abilities included in the farm-structures area as individual items, and each is classified into three statuses as follows: (1) importance interval, (2) training interval, (3) extent of agreement. The presentation included the use of the original list of abilities and the three statuses of each item were extracted from the scatter diagram in Figure 7.

The subarea, general principles, together with tool care, contain approximately one-fourth of the abilities that are located in the three highest intervals of importance and

and training scores. Four other subareas were represented in the three highest intervals of importance with six abilities each as follows: construction, painting and glazing, concrete and masonry, and repair of farm structures.

The list of farm-structures abilities contains fourteen that are classified as managerial, forty-seven as manipulative, and nine as combination types. The managerial and combination types averaged above the distribution level, while the manipulative type fell below the average.

Of the fourteen managerial abilities included, one-half belong in the subarea of general principles. Two subareas, related woodwork and construction, were comprised entirely of manipulative abilities.

Teachers' Suggestions for Ability Development

A majority of the teachers included in the farm structures phase of the investigation made suggestions for improving the development of abilities in the college instructional program in farm mechanics. A total of 137 suggestions were submitted, and these have been condensed into six classifications. The summary of these data is presented in Table XXXIII. A study of that information shows that the majority of suggestions referred to additions to the instructional program, i.e., there were few proposals to omit anything.

TABLE XXXIII

TEACHERS' SUGGESTIONS FOR IMPROVING THE DEVELOPMENT OF ABILITIES IN THE COLLEGE TRAINING PROGRAM IN FARM STRUCTURES*

Suggestions Listed in the Order of Frequency Checked	Number of Teachers Checking (Total)	Number of Suggestions (Total)
A. Add Courses in Farm Structures	23	37
1. Construction of barns and milking parlors.		
2. Swine and poultry housing.		
3. Planning buildings and estimating costs.		
4. General woodworking		
5. Repair of buildings		
B. Omit Course(s)	3	3
1. Parts of course in farm homes		
C. Add Units of Instruction	22	35
1. Designing and repairing farm structures		
2. Planning for economical use and construction		
3. Insulation and ventilation systems		
4. Painting		
5. Floor plans of barns, remodeling		
D. Omit Units of Instruction	2	3
1. Making small items such as window frames		
2. Related woodworking skills		
E. Add Activities	26	52
1. Field trips		
2. Actual repair of buildings		
3. Select and identify lumber		
4. Read and interpret blueprints		
5. Frame small buildings		
6. Paint small structures		
7. Finish concrete, set forms		
F. Omit Activities	6	7
1. Over-doses of lectures, slides and movies in laboratory periods		
Totals		137
Average number per teacher		3.5

* Includes items listed by two or more teachers.

The greatest number of proposals made in any classification relate to the "addition of activities", while the number of suggestions made in regard to "adding courses", and "adding units of instruction" are about equal. The total number of suggestions made represent an average of 3.5 per teacher.

Suggestions in Regard to the Addition of Course(s) in Farm Structures

After condensing the thirty-seven items suggested into related units, there are four courses proposed in farm structure. The majority of these suggestions included course content relating to (1) planning and designing barns, (2) service buildings, (3) animal housing of various types.

Suggestions for Omitting Courses in Farm Structures

The total number of suggestions received to omit courses in the farm structures area was so small that this phase of the analysis was considered to have little importance in the study.

Proposals for the Addition of Units of Instruction

The data in Table XXXIII show that teachers made a rather large response to the question regarding the addition of units to the farm structures course(s) taken in college. The total of thirty-five suggestions were condensed into a

list of five common items representing the responses of twenty-two teachers. A study of the data shows that the items checked most frequently in this classification relate to the (1) designing, (2) planning, and (3) repairing of farm structures.

Proposals to Omit Units of Instruction from the Farm Structures Course(s)

The number of suggestions made in regard to omitting units of instruction is so small that this section is considered to be of little importance to the investigation.

Suggestions Relative to the Addition of Class Activities

Of the six major classifications in this phase of the study the maximum response was received in regard to the addition of activities. Table XXXIII shows that a total of fifty-two suggestions were recorded and a total of twenty-six teachers participated in this section of the study. The total number has been condensed into a list of seven common items. The data in Table XXXIII show the order in which each is listed most frequently.

The suggestion that appears most frequently is to use more field trips. This idea is suggested in connection with a large number of different phases of farm structures instruction; the respondents stress the need for adequate planning of these trips, and they suggest that field trips be directly related to the instruction at hand. Several proposals were made that some kind of actual repair of farm structures be provided while other suggestions include class activities in selecting lumber, reading blueprints, framing small buildings, painting, making concrete, and the like.

Proposals for Omitting Class Activities

The proposal to omit class activities again did not receive sufficient response to be included in the analysis. A number of statements appeared on the forms to the effect that "more activities should be added, not omitted".

Teachers' suggestions relative to some ways and means to improve the development of abilities in college courses revealed the following:

1. A large majority of teachers made suggestions of one kind or another as a means of improving the development of farm-structures abilities in college course-work. There were a total of 137 separate proposals made in this respect, but this number included duplications of ideas because of the unstructured nature of the instrument used.

2. A total of thirty-seven suggestions were made for adding courses and these were condensed and presented as four proposals for new courses in farm structures. Twenty-three teachers made suggestions of this type. Course titles

most frequently suggested include several aspects of the construction and planning of barns.

3. Few proposals were made of any importance in response to the proposal to omit courses in the area of farm structures.

4. A total of twenty-two teachers suggested thirty-five different units of instruction to be added to the course work in structures. These were condensed into five common items. The units listed most frequently are (1) construction, (2) designing, and (3) planning farm buildings.

5. There were few important responses obtained in the section regarding the omission of units of instruction.

6. The section on adding activities received a total response of fifty-two suggestions reported by twenty-six teachers. The fifty-two items were condensed and presented in the form of seven most common types of activities, headed by the item "field trips".

7. The last classification on the list, relative to the proposal to omit class activities, shows only seven suggestions as reported by six teachers, and these related to (1) reducing the amount of lecture in laboratory.

Supplementary Experiences of Teachers

The information on which Table XXXIV is based reveals that the most valuable supplementary experience reported by

teachers is a general farm background acquired through living, and being reared on a farm. The term "supplementary experiences" refers to experiences other than college course work. Approximately three-fourths of the total number of teachers reported this item as having made a contribution to their teaching ability in farm structures.

The second most important experience was reported as being some type of construction work, listed by almost one-third of the teachers included in the farm-structures phase of the study. Actual teaching experience, and outside assistance received from professional workers were reported by smaller groups of teachers as having made a contribution to their ability to teach farm-structures activities.

The other experiences reported included attendance at in-service training meetings, and specialized work such as wiring or painting a house. The latter two experiences were listed by a smaller number of teachers, but these items indicate some avenues by which teaching ability is improved in the area of farm structures.

A review of the data in Table XXXIV reveals that the number of experiences reported by thirty-nine teachers included in the farm-structures area averaged 1.53 percent per teacher; sixty separate listings were condensed, and presented as six types of experiences; farm background was rated as a valuable experience for a teacher of vocational agriculture;

TABLE XXXIV

SUPPLEMENTARY EXPERIENCES REPORTED BY 39 TEACHERS AS HAVING IMPROVED THEIR ABILITY TO TEACH FARM-STRUCTURES ACTIVITIES

Kind of Activity Reported	Number of Teachers Reporting	Percent of Teachers
1. Practical experience acquired through living on a farm.	29	74.3
2. Experience in construction of buildings	12	30.8
3. Teaching vocational agriculture, contacts and experience	6	15.4
4. Assistance received from professional workers	6	15.4
5. Participating in in-service training clinics	4	10.2
6. Doing specialized work such as painting and wiring	3	7.7
Total Number Experiences Reported - 60		
Average Number per Teacher (39 Teachers)- 1.53		

construction work of various types was also reported quite frequently in this connection. Actual teaching experience, professional assistance received, and in-service training meetings are other means by which teachers improved their teaching abilities in farm structures.

Note: The major findings have been reviewed at the end of each section of analysis in this chapter.

CHAPTER VI

SUMMARY, CONCLUSIONS, IMPLICATIONS FOR TEACHER PREPARATION, AND RECOMMENDATIONS FOR FUTURE STUDY

Summary

This is the report of a study pertaining to the preparation of Michigan teachers of vocational agriculture in two areas of farm mechanics. The investigation and the writing of the report covered the period of September 1954 to June 1955, inclusive. The data used in the investigation were supplied by a composite sample consisting of: (1) eighty Michigan teachers of vocational agriculture experienced in teaching farm mechanics; (2) forty-two farmer members of advisory councils serving local departments of vocational agriculture in the state of Michigan; (3) Michigan teacher-education personnel composed of (a) five state consultants in agricultural education, (b) five regular members of the staff, and one graduate assistant, in agricultural education of the department of vocational education of Michigan State University, (c) five supervising teachers of the agricultural education service of Michigan State University; and (4) fourteen members of the staff in agricultural engineering of Michigan State University.

The teachers of vocational agriculture reporting in this study taught in eighty schools which were located in

forty-one counties in Michigan. The general areas of the state were well represented with the exception of the upper peninsula. The range of experience of teachers included in this report was from one to seventeen years, and they received their training in farm mechanics at Michigan State College. Farmer members of advisory councils included in the study represented nine departments of vocational agriculture in seven counties; farm mechanics was taught in these departments as a regular phase of the instruction.

Type of farming engaged in, age, and status of ownership of the respondents were not considered in selecting the samples of farmers in this study. Local teachers of vocational agriculture classified the advisory council members as to farmers, and provided the names and addresses of the members. Staff members in agricultural engineering at Michigan State University included in the report were experienced in the area of farm mechanics in which the member reported. Supervising teachers included in the report had two or more years of such experience, while the one graduate assistant in agricultural education had institutional experience in another state.

The data used in this investigation were obtained by having the respondents check two lists of farm-mechanics abilities needed by Michigan teachers of vocational agriculture. The two lists pertained to (1) the area of farm structures containing seventy abilities in seven subareas, and (2) the area of farm shop, containing 110 abilities in nine

subareas. The two lists of abilities were validated by having members of the staff in agricultural engineering of Michigan State University check the contents of the lists; further validation was provided by leaving the end of each list open for additions by the respondents.

Some of the 152 individuals included in the report participated in both areas of the study resulting in two composite samples of 106 respondents in farm shop and 109 in farm structures.

One hundred six respondents checked the importance of seventy abilities in farm-structures while 109 respondents checked the importance of 110 farm-shop abilities. The importance of each item in teaching vocational agriculture was checked as to: (1) essential, (2) moderate, and (3) none; arbitrary values of 10-5-0 points respectively were assigned to these responses. Forty-one Michigan teachers of vocational agriculture checked the adequacy of training received in the same farm-shop abilities as to (1) adequate, (2) moderate, and (3) none; arbitrary values of 10-5-0 points respectively were assigned. Thirty-nine Michigan teachers also checked the farm-structures abilities according to the plan cited in farm shop relative to the training.

The scores of the four groups of respondents were tabulated separately to provide a basis for studying group homogeneity. Composite tabulations were made for farm shop and farm structures by combining the scores of the four groups in each area as a basis for determining the importance of 180 abilities in the two areas. The totals of the teachers' training scores in each area were used to check the extent of agreement between the relative importance of farm-mechanics abilities in teaching vocational agriculture in Michigan and the adequacy of the training received.

Teachers were asked to suggest ways and means of improving on the development of abilities in college courses.

The review of the literature pertaining to farm mechanics, and to the preparation of teachers in this phase of vocational agriculture, covered the period of 1920 to 1954 and included twenty-three major studies either directly involving farm mechanics, or pertaining directly to the methods and techniques used in the present investigation. One major study in farm mechanics has been reported in Michigan based upon the area organization of the field, and this study included data pertaining to the mechanical activities of 676 farmers.

Homogeneity of Groups Included in the Study

Several tests were conducted in the study of group differences and similarities. The findings in regard to group homogeneity in farm shop were similar to those in the farm-structures phase of the analysis. The major points of difference and/or similarities of the groups in both areas are summarized as follows:

1. The four groups of respondents showed small deviations from the composite samples, in both areas, when comparisons were made on the basis of group percentage scores of the total area.

2. The teacher-education group tended to check the importance of farm-mechanics abilities slightly higher than did other groups. Agricultural engineers and farmers were about evenly divided in checking the importance lowest.

a. The teacher-education group was found to be significantly different from agricultural engineers in the farm-structures areas, based on the "t" test. Other between-group variations were so small that the overall tests of "t" were not conducted.

3. Ninety-six group tests based on individual-item scores revealed some lack of agreement between various pairs of groups. In the main, however, the points of difference involved the units that were found to be of least importance in farm shop and farm structures, such as rope work, sheet metal, etc. There were a few exceptions to this general rule.

4. The overall agreement between groups, as revealed by various tests, was found to be high and the composite samples were considered to be homogeneous.

Relative Importance of and Adequacy of Training in Farm Shop

1. The overall importance of 110 farm-shop abilities included in this study was found to be high, assuming that the

scoring device is a valid instrument for assessing the importance. The composite importance score in farm shop is 78.7 percentage points when expressed as a percent of the highest possible score.

2. The range in percentage scores of importance of the nine subareas in farm shop is from 56.56 percent on forge work, to 89.15 percent on tool care.

3. On a percentage basis, the subareas of (a) tool care, (b) general principles, (c) arc welding, (d) pipe fitting, (e) cold metal, and (f) oxy-acetylene welding were found to be the most important units in the descending order as listed.

4. The three subareas that were rated lowest in importance in farm shop were (a) forge work, (b) rope work, and (c) sheet metal.

5. There was high agreement among the groups as to the rank order of importance of the nine subareas in farm shop.

6. The training in farm shop was checked as being most adequate in sheet-metal and rope-work abilities, followed by (a) cold-metal, (b) tool-care, and (c) arc-welding abilities in that order; the training was checked as being the least adequate in (a) forge-work, (b) pipe-fitting, and (c) oxy-acetylene-welding abilities. The training adequacy was checked as average-to-low in general-principles and oxy-acetylene-welding abilities.

7. The overall agreement between the 110 training scores and the 110 importance scores, as revealed by the Pearson coefficient of correlation was high, however, the importance and training were not in agreement when the rank orders of the nine subareas were compared. The largest discrepancies between the training and the importance were in sheet metal and rope work, both of which were six ranks out of order.

a. Tool care and general principles, rated highest in importance, were out of agreement with the training by three and four ranks respectively. The importance in pipe fitting was four ranks higher than the training was in that unit.

8. In the main, the scores of the individual abilities followed the pattern of the importance and training of the subareas, although there were some exceptions to this generalization, i.e., a few abilities in low subareas were scored high in importance while a few low-scored items were found in high-scored subareas.

9. An item analysis showed that the greatest need was for a general increase in the training emphasis of the managerial type of abilities such as selecting and purchasing shop equipment, using shop equipment effectively, and the like, followed by a need to decrease the emphasis in such abilities as splicing rope, soldering, etc. Some general increases were indicated also in teaching tool-care abilities.

10. A sub-analysis in the item study showed that the managerial type of abilities were scored higher in importance than were the manipulative type; the training, on the other hand, was highest in the manipulative group, and was lowest in the managerial type.

11. If a 20 percent cutting point were established at the bottom of the importance scale, the area of forge work would be practically eliminated while sheet metal and rope work would be reduced.

Relative Importance and Adequacy of Training in Farm Structures Abilities

1. The overall importance of seventy farm-structures abilities was scored at 72.37 percent of the highest possible score; the range of the importance of the seven subareas is from 56.51 percent on related wood-work to 85.98 percent on use and care of tools.

2. On the basis of percentages the subareas of (a) (a) use and care of tools, (b) concrete and masonry, (c) general principles are the highest ranking units in importance, in the order stated, although there was less than one percentage point of difference between (b) and (c). These three subareas are followed by (a) repair of structures and (b) construction of farm buildings in the order of importance. The two subareas rated as the lowest in importance are (a) painting and glazing, and (b) related woodwork.

5. There was relatively high agreement between the total distributions of the training and the importance scores when tested by the Pearson coefficient of correlation.

6. The training and importance scores of the seven subareas were found to be in general agreement, the largest discrepancy occurring in the repair of farm structures; this unit was rated lowest in the training, while the importance was rated fourth; this was a three-rank discrepancy in the series of seven.

7. An item analysis showed that the greatest need for shifting the training emphasis in order to improve the agreement between the training and the importance was as follows: (a) increase the emphasis in teaching the repair of buildings, such as, determining the need for repairs, and repairing foundations; (b) increase the emphasis in teaching the abilities in general principles such as planning farm structures in accordance with principles of economics and functional requirements; (c) increase the emphasis in painting farm machinery using metal paint, and treating lumber with preservatives; decrease the emphasis in concrete and masonry, in such items as mixing and placing concrete, and in laying concrete masonry blocks.

8. A sub-analysis in the item-study showed that the managerial type of abilities scored above-the-average of the distribution on the importance scale; the manipulative type scored slightly below-the-average in this respect.

9. If a 20 percent cutting point were established at the low end of the importance distribution, the majority of the abilities in the subarea of related woodwork would be eliminated with the exception of one item in this unit that received a high score, namely, construction of ordinary wood projects.

Teachers' Suggestions and Experiences

The suggestions that were made in regard to the improvement of ability development in college course work were in general agreement with previous findings of the study. The report showed that teachers advocate a large amount of activity in project construction, tool use, tool fitting, selection of equipment, well planned field trips, activities in the planning of animal housing, and a good many others. The responses in this section of the survey forms were unstructured; because of this it was necessary to condense them to obtain workable data.

Four types of experience, outside of college course work, stood out as being most valuable in the improvement of teachers' farm-mechanics abilities: these were listed as farm background, actual teaching experience, construction work, and factory work. Other supplementary experiences that were reported as having improved the teachers' abilities in farm mechanics were: in-service training meetings, and professional instruction received from various sources. Only those items with two or more checks were included in this phase of the study.

Conclusions

The conclusions that follow are based upon the opinions of Michigan people who were associated with vocational education in agriculture in some important capacity; they were selected in accordance with general and specific criteria relative to the areas of farm shop and farm structures in farm mechanics. The use of samples of respondents selected under similar conditions might be expected to produce equally valid results in other areas of farm mechanics. These conclusions apply within the limitations that were discussed in the opening chapter.

1. There was general agreement among the four groups included in this investigation in regard to the relative importance of farm-structures and farm-shop abilities in the teaching of vocational education in agriculture indicating that the composite sample represented a homogeneous grouping.

a. The most consistent variation in the agreement among groups was the tendency of the teacher-education group to score the importance of abilities higher in both areas of farm mechanics. This tendency was not believed to be very important in the subsequent analysis.

2. A large majority of farm-shop abilities that appear to be of the highest importance in teaching vocational agriculture are included in the units of (a) general principles, (b) tool care, (c) arc welding, (d) oxy-acetylene welding;

the farm-shop abilities of average importance are included in the units of pipe fitting and cold metal, in the main. The abilities that appear to be the least important in teaching farm shop work in vocational agriculture are included in sheet metal, rope work, and forge work.

3. A large majority of farm-structures abilities that appear to be of the highest importance in teaching vocational agriculture are included in the units of use and care of tools, general principles, and construction of farm buildings. Abilities in (a) concrete and masonry and (b) repairing farm buildings, apparently, are of average importance in teaching, while (c) painting and glazing and (d) related woodworking appear to be the least important to the teacher of vocational agriculture in Michigan.

4. The training in farm-shop, apparently, was most adequate in (a) rope-work, (b) sheet-metal, and (c) cold-metal abilities, while (d) tool care, (e) arc welding, and (f) general principles represent the average in terms of training; abilities in (a) pipe fitting, (b) oxy-acetylene welding, and (c) forge work, evidently, were the least adequately taught in farm shop.

5. The training in farm-structures abilities apparently was most adequate in the units of (a) use and care of tools, and (b) concrete and masonry; the training appears to have been of average adequacy in the abilities in (a) general principles, (b) construction of buildings, and (c) painting

and glazing; the abilities in (a) related wood work and (b) repair of farm structures were the least adequately trained in this area.

6. In the area of farm shop there was some lack of harmony between the training and the importance in the units of rope and sheet metal work, in the direction of overemphasis of the training; apparently the training in the units of general principles and pipe fitting had been underemphasized.

7. In the area of farm structures the overall agreement between the training and the importance of various units was not badly out of balance, with the exception of the one unit, repairing farm buildings and structures, which appears to have been underemphasized.

8. If the present adequacy of training in farm shop and farm structures is the same as that reported in this study, it appears that the agreement between the training and the importance of various abilities in both areas should be adjusted; substantial evidence indicated that the harmony between these two factors could be improved by (a) increasing the instructional emphasis in such abilities as selecting and purchasing shop equipment, and (b) by decreasing the emphasis in such abilities as splicing rope.

9. Considering that the indices representing the adequacy of training in this study refer to instruction that was received over the past several years, the data available appeared to be adequate as a basis for preparing a detailed

item-guide for evaluating the training and importance of each ability; the completed guide, including 180 farm-mechanics abilities, appeared to be a valuable discriminative device in planning teacher-preparation courses in farm shop and farm structures.

10. The type of data available in this study pertaining to the instruction was of such nature that it was not possible to evaluate the "adequacy of the training" in terms of an absolute score, or level. The training scores available appeared to be a valid measure of the relative adequacy of training as between abilities or units. There was, however, a wide disparity between the general level of importance and the general level of the training in both areas.

11. On the average, the managerial abilities in both areas of the study appear to be more important in teaching vocational agriculture than are the manipulative type, but the training tended to be more adequate in the manipulative abilities than in the managerial abilities included in the study.

12. Apparently the teachers included in this report felt that the development of farm-mechanics abilities in college courses could be improved in the following ways; by (a) using more field trips of the proper nature, (b) by increasing student participation in project construction, (c) by providing more activities in the planning of school-farm

shops and farm service buildings, and (d) by increasing student activities in tool selection and tool processes.

13. The most valuable supplementary experiences of Michigan teachers of vocational agriculture, as a means of improving their farm-mechanics abilities, apparently were (a) farm background, (b) teaching vocational agriculture, (c) factory work, and (d) construction work. It was not possible to evaluate the effect of these reported experiences on teaching performance with the data available.

Implications for Teacher Preparation

1. Considering the uniform results obtained from the different groups in the investigation, there is reason to believe that properly selected samples of these different groups would produce equally uniform and valid results in future investigations in farm mechanics and/or other fields of technical agriculture. Properly selected samples of individuals from within these groups might be expected to express equally valid opinions.

2. The low importance ratings of forge work, sheet metal, and rope work, in comparison to the relatively high importance ratings of the two units in welding, indicate that the needs of Michigan teachers of vocational agriculture are changing. It appears desirable, therefore, that periodic investigation be made as a basis for keeping the college

instruction current with the developments in agriculture in the state.

3. In view of the need for continuous curriculum study, and the homogeneity of the Michigan groups involved in teacher education, it appears desirable to utilize advisory personnel selected from these groups in making periodic studies in farm mechanics and other areas for instructional planning.

4. There were indications that teaching content tends to remain in college courses for teacher preparation; therefore, the use of some type of scoring device, similar to the one that was used in the present study, might be useful in helping to determine what should be deleted from the course(s). New offerings might be determined on a similar basis.

5. The findings relative to the different types of abilities studied are suggestive of a need for improving or changing the instructional approach used in teaching the managerial abilities. New methods and techniques may be needed in teaching some of the highly important managerial abilities that appear to have been inadequately taught in the past.

6. The consistency of certain elements in teachers' suggestions for improving on the development of abilities in college courses leads to the general statement that teacher perparation in farm mechanics in Michigan might be improved by including more activities and experiences that are similar

in nature to those required in teaching vocational agriculture at the local level.

7. If the farm-mechanics needs of local farm people are considered to be a valid basis for determining the teacher-preparation curriculum in this field, it would follow that the bases for teacher-preparation curricula in other areas of agriculture should be founded upon the needs of local communities.

Recommendations for Future Study

1. Although the design of the present investigation is not free of defects, the results obtained were sufficiently uniform and consistent that the general method, and some of the techniques used, are recommended for future studies of a similar nature.

2. The scoring scale used in the study should be improved, perhaps by constructing it on a continuum.

3. Some changes should be made in the system used to designate the varying degrees of importance and adequacy of training; the use of a continuum might help eliminate this difficulty in the scoring.

4. The design of studies of this nature should be fashioned so that the tabulation of the data could be accomplished through the use of machine-scored cards.

5. The many suggestions made during the investigation relative to the problems and needs of teachers in farm power and machinery prompts the recommendation that this area of farm mechanics should be investigated along the lines of the present study. In addition, the areas of rural electrification and soil and water management represent important phases of local programs of vocational agriculture. These areas should be investigated to determine what the current needs of teachers are as a basis for instructional planning at the college level.

6. The quality of the farm-mechanics training was not evaluated in this study except as a contributory factor in the development of abilities; future studies of a similar nature should include some means of evaluating this aspect of the instruction in the teacher-preparation phases of farm mechanics.

LITERATURE CITED

Books

Cook, G. C., Walker, Clyde, and Snowden, O. L. Practical Methods in Teaching Farm Mechanics, The Interstate Printers and Publishers, Danville, Ill., 1952. 658 pp.

Garrett, H. E. Statistics in Psychology and Education, Longmans, Green and Company, New York., 1953. 460 pp.

Hamlin, H.M. Agricultural Education in Community Schools, The Interstate Printers and Publishers, Danville, Ill., Second Printing, 1950. 488 pp.

Lancelot, W. H. Permanent Learning, John Wiley and Sons, Inc., New York, Third Printing, 1947. 221 pp.

Bulletins

Agricultural Education, Organization and Administration. Part I, Vocational Bulletin, 13. Washington: U. S. Office of Education, Revised 1939. 50 pp.

Armstrong, Fred E. Farm Repair and Construction Work, Educational Monograph No. 4. Minneapolis: University of Minnesota, 1923. 38 pp.

Coggin, J. K. and Giles, G. W. Farm-Shop Activities and Equipment, Bulletin 5. University of North Carolina, Raleigh, N. C. 65 pp.

Educational Objectives in Vocational Agriculture, Vocational Division Monograph, No. 21, Washington: U. S. Office of Education, 1940.

Farm Mechanics for California Schools, Agricultural Education Series, No. 2, Division Bulletin, No. 11. Berkeley: University of California, 1922. 45 pp.

Struck, Theodore F. Farm Shop Work in Pennsylvania, Rural Life Department, Special Bulletin No. 1, Pennsylvania State College, State College, Pennsylvania, 1920. 85 pp.

Periodicals

Ahalt, Arthur M. and Miller, Harry. "Technical Skills Needed in Farm Mechanics", *The Agricultural Education Magazine*, 27: 7, January, 1955.

Chestnutt, S. L. "A Plan of Organizing Instruction". *The Agricultural Education Magazine*, 18: 128-129, January, 1946.

Publications of Learned Organizations

"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, American Society of Agricultural Engineers, 1944.

Agricultural Engineering Phases of Teacher Training for Vocational Agriculture, Report II. Pre-Service and In-Service Training Programs, The American Society of Agricultural Engineers, St. Joseph, Michigan, 1953.

Unpublished Materials

Cook, G. C. and Byram, H. M. "Mechanical Activities of Selected Farmers in Michigan," Research Project in Agricultural Education, Library of Michigan State College, East Lansing, 1952. 136 pp.

Davidson, Allen P. "A Study of Farm Shop and Agricultural Engineering of Kansas Farms: Its Relation to Vocational Agriculture in Kansas High Schools," Unpublished Master's Thesis, Kansas State College of Agriculture, Manhattan, 1925. 40 pp.

Davies, L. R. "Farm Shop Work in Vocational Education," Unpublished Master's Thesis, Colorado Agricultural College, Fort Collins, 1923. 94 pp.

Geiger, Albert James. "A Study of Farm Shop Work in Florida," Unpublished Master's Thesis, University of Florida, Gainesville, 1932. 106 pp.

Hollenberg, A. H. "Farm Mechanics Today and Tomorrow," The U. S. Department of Health, Education and Welfare, Office of Education, Division of Vocational Education, Washington, D. C., 1954. 10 pp.

Hutson, Denver B. and Ekstrom, G. F. "A Study of the Training Needs for Prospective Teachers of Vocational Agriculture," Nonthesis Study, University of Missouri, Columbia, Missouri, 1952. 20 pp.

Kennedy, Arthur C. "A Study of the Needs for Training in Farm Mechanics in Ohio," Unpublished Master's Thesis, Ohio State University, Columbus, 1927. 57 pp.

Kirkland, J. B. "A Study of the Professional and Technical Difficulties Encountered by Teachers During Their First Year of Teaching Vocational Agriculture," Unpublished Doctor's Thesis, The Ohio State University, Columbus, Ohio, 1947. 464 pp.

Matela, A. G. "Content of Curriculum for Teachers of Vocational Agriculture in Separate Land-Grant Colleges," Unpublished Master's Thesis, Iowa State College, Ames, Iowa, 1949. 124 pp.

McCreight, M. G. "A Study of the Use of Acquired Farm Mechanics Abilities by Selected Vocational Agriculture Graduates of Nebraska Public Schools," Unpublished Master's Thesis, University of Nebraska, Lincoln, 1951.

Mulligan, Clarence W. "A Study of the Needs for Training in Farm Mechanics in New York State," Unpublished Master's Thesis, Cornell University, Ithaca, New York, 1941.

Proctor, Phillip W. "A Course in Farm Mechanics for Pittsfield, Illinois, Community High School," Unpublished Master's Thesis, Colorado State College of Agriculture and Mechanical Arts, Fort Collins, 1941. 59 pp.

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, The Ohio State University, Columbus, Ohio, 1943. 342 pp.

Ryder, Gordon. "A Program of Teacher Evaluation in Farm Mechanics Education for Vocational Agriculture Teachers," Unpublished Doctor's Thesis, Ohio State University, Columbus, Ohio, 1954.

Ryder, Gordon. "Skills Needed by Farmers in Selected Areas of Farm Mechanics," Nonthesis study, Ohio State University, Columbus, Ohio, 1953. 24 pp.

Sharp, Marley A. "A Suggested Course of Study in Farm Mechanics for High Schools Based on the Opinions of Five Hundred Farmers," Unpublished Master's Thesis, Iowa State College, Ames, 1928. 37 pp.

Walker, Clyde. "Determining the Content of Farm Mechanics Courses of Study for Smith-Hughes Agricultural Departments in High Schools," Unpublished Master's Thesis, The University of Nebraska, Lincoln, 1931. 80 pp.

White, Conrad P. "Factors Associated with Certain Abilities Possessed and Jobs Taught in Selected Livestock Enterprises by Teachers of Vocational Agriculture in Michigan," Unpublished Doctor's Thesis, Michigan State College, East Lansing, Michigan, 1953. 175 pp.

Wright, Carlton E. "A Study of the Needs for Training in Farm Shop in High School Departments of Vocational Agriculture in the State of Vermont," Unpublished Master's Thesis, Cornell University, Ithaca, New York, 1936. 120 pp.

Zindel, Howard. "A Study of Graduate Reaction to the Animal Industries Curricula at Michigan State College," Unpublished Doctor's Thesis, Michigan State College, East Lansing, Michigan, 1953. 175 pp.

Miscellaneous

Murray, James A. H. A New English Dictionary on Historical Principles, Volume I, Oxford: At the Clarendon Press, 1888. P. 20.

APPENDICES

A. Names of Respondents Included in the Study

1. Agricultural Engineers
2. State Leaders in Teacher Education
3. Farmer Members of Advisory Councils
4. Teachers of Vocational Agriculture

B. Specimen sheet of questionnaire sent to respondents listed in Appendix A.

C. List of farm shop abilities

D. Farm Shop Data

E. List of Farm Structures Abilities

F. Farm Structures Data

APPENDIX A

Names of Respondents Included in the Study

1. Agricultural Engineers

(Name)	(Place)
Carl F. Albrecht	Michigan State College, East Lansing
George Amundson	Same
M. L. Bailey	Same
James S. Boyd	Same
T. J. Brevik	Same
D. P. Brown	Same
Walter M. Carleton	Same
William Friday	Same
Carl Hall	Same
Clarence M. Hansen	Same
Chester Mackson	Same
Howard F. McColly	Same
Walter H. Sheldon	Same
Robert G. White	Same

2. State Leaders in Teacher Education

Joe P. Bail	Same
H. M. Byram	Same
Raymond M. Clark	Same

State Leaders in Teacher Education, Cont.

Raymond A. Garner	Michigan State College, East Lansing
H. P. Sweany	Same
Guy Timmons	Same
Harry E. Nesman	State Vocational Office, Lansing
Elmer A. Lightfoot	Same
Charles L. Langdon	Same
L. H. Kelly	Same
Burton K. Thorn	Same
Duane W. Dalgleish	Owosso, Michigan
Edwin St. John	Charlotte, Michigan
Clyde B. Ray	Charlotte, Michigan
L. A. Cheney	Williamston, Michigan
Henry W. Kennedy	Williamston, Michigan

3. Teachers of Vocational Agriculture - Respondents in Farm Shop

(Name)	(School)
Lester P. Bollwahn	Allegan
Joseph P. Marzec	Athens
William J. Garvey	Bellevue
Duane F. Seelye	Boyne City
Russell Spalding	Britton
F. Paul Nevel	Carleton
Clayton E. Preisel	Carson City
Norwin W. Braun	Chesaning
John D. Anibal	Clinton

Respondents in Farm Shop, Cont.

Allen E. Kohn	Edmore
Dale F. Hines	Farwell
Howard E. Bryant	Fennville
Alfred O. Niemi	Galesburg
William H. Knight	Gaylord
James E. Overly	Grass Lake
Robert Schaefer	Hanover
Carl Hall	Hartland
Bruce G. Mitchell	Holly
Charles W. Pelham	Hopkins
Richard Pfister	Imlay City
Russell J. Johnson	Lakeview
Eckhard D. Sell	Lawrence
Richard Speicher	Litchfield
Edward R. Cole	Mayville
Russell N. Howes	Merrill
Lowell W. McMillen	Niles
Reuben M. Kaare	Oscoda
Leland Warschefsky	Owendale
Raymond Hill	Owosso
Clifford H. Walsh	Parma
Richard L. Pardun	Pellston
Howard L. Thompson	Pigeon
Clark H. Bullen	Portland
Robert J. Middleton	Rochester
Fred Peabody	Saranac

Respondents in Farm Shop, Cont.

Richard Bell	Scottville
Douglas A. Claflin	Sheridan
Walfred S. Tollefson	Ubly
Kenneth L. Chichester	Vicksburg
James W. Sheppard	West Branch
Ross L. Lindsay	Yale

Teachers of Vocational Agriculture - Respondents in Farm Structures

Herbert G. Avey	Bad Axe
August H. Lange	Berrien Springs
William E. Drake	Breckenridge
Robert E. Braden	Byron
James C. Sutherland	Caro
Clayton H. Wells	Coldwater
Donald Stormer	East Jordan
Lyle H. Myers	Fremont
Edward R. Noll	Goodrich
Arnold Loomis	Hale
James D. Schell	Hillman
Lawrence Pancost	Homer
Robert J. Van Klompenberg	Hudsonville
Leon J. Alger, Jr.	Ida
Ronald H. Mulvaney	Ionia
Dale H. Schairer	Lake Odessa
Russell J. Miller	Leslie
Robert C. Hatfield	Marcellus

Respondents in Farm Structures, Cont.

George P. Jungel	Mattawan
Peter J. Sikkema	McBain
Earl C. Maier	Mesick
Max E. Huff	Morenci
Owen G. Lyons	Nashville
Rolf E. Moeckel	Olivet
Howard D. Bernson	Onsted
Melvin W. Simonton	Peck
Thomas D. Fagan	Petersburg
Robert C. Reasner	Pinconning
Donald J. DeKeyser	Powers
Earl J. French	Reese
Carl D. Nelson	St. Charles
James W. Lilley	Saline
Louis F. Reuter	Sandusky
John A. Fuller	Sebewaing
Paul F. Burns	Tecumseh
John Jocham, Jr.	Unionville
Harold D. Samuelson	Wayland
Lucian G. Hatfield	Whittemore
Harold R. Long	Woodland

4. Farmer Members of Advisory Council

(Name)	(School)
Jim Chestnut	Allegan
Clarence Hiscock	Same
Harry Immink	Same
Howard Peters	Same
Vern Neidlinger	Britton
Lloyd Wagner	Same
Harold Rhorback	Same
Joe Kelly	Same
Dale Gilson	Same
Frank Gerver	Same
W. A. Wehner	Same
Eldon Reeck	Same
Leslie M. Sheridan	East Jordan
Frank Hayden	Same
Robert Shepard	Same
George D. Nelson	Same
Leo Woodhams	Gaylord
Carl Widger	Same
Don Harris	Mayville
Ward Smith	Same
George Foster	Same
Earl Haas	Same
Alton DeGrow	Same
Clifton Lotter	Same

Farmer Members of Advisory Council, Cont.

Curtis Blair	Same
Dale Redfield	Onstead
M. F. Smith	Same
Orval Chatfield	Same
Glenn Keck	Same
Ed Baumgartner	St. Charles
Clifford Simons	Same
Morton Olson	Same
Arthur Eaton	Tecumseh
Archie Shaffler	Same
Herman Dick, Jr.	Same
Clarence Wagner	Same
Donald Cope	Yale
Dale Travis	Same
Raymond Hazel	Same
Clyde Bell	Same
Mrs. Marion McCollum, Sr.	Same
Mrs. Wilbur Place	Same

APPENDIX B

Specimen Sheet (page 1) of Questionnaire Sent to Respondents Listed in Appendix A

A STUDY OF ABILITIES NEEDED BY TEACHERS OF VOCATIONAL AGRICULTURE IN TEACHING FARM MECHANICS

ABILITIES NEEDED IN TEACHING (The term *Ability*, as used in this study, denotes adequate knowledge and understanding of each activity, plus a reasonable amount of skill in doing it.)	IMPORTANCE OF EACH ABILITY IN TEACHING			DESCRIPTION OF YOUR COLLEGE TRAINING IN EACH ABILITY*		
	Essential	Moderate	None	Adequate	Moderate	Had No Training
I. Area: FARM BUILDINGS AND STRUCTURES						
A. General Principles -- Ability to:						
1. Plan farm structures according to sound principles of economics.	( )	( )	( )	( )	( )	( )
2. Plan structures according to functional requirements of various agricultural enterprises.	( )	( )	( )	( )	( )	( )
3. Estimate size, capacity and cost of farm structures.	( )	( )	( )	( )	( )	( )
4. Select most desirable building materials.	( )	( )	( )	( )	( )	( )
5. Make simple drawings of farm structures.	( )	( )	( )	( )	( )	( )
6. Read and interpret blue prints.	( )	( )	( )	( )	( )	( )
7. Plan the location of buildings in relation to the farmstead.	( )	( )	( )	( )	( )	( )
8. Prepare a standard bill of materials.	( )	( )	( )	( )	( )	( )
9. Design or select joists and beams for strength.	( )	( )	( )	( )	( )	( )
10. Design the insulation and ventilation plans for structures according to requirements of various agricultural enterprises.	( )	( )	( )	( )	( )	( )
11. Locate and use Building Manufacturers "Plans Services".	( )	( )	( )	( )	( )	( )
Others:						
12.	( )	( )	( )	( )	( )	( )
13.	( )	( )	( )	( )	( )	( )

Note: Other sections of this study followed the same form.

* Only teachers checked the training.

APPENDIX C

List of Farm-Shop Abilities Included in the Study

Area: Farm Shop

A. General Principles -- Ability to:

1. Plan school-farm shops according to the instructional needs in the community.
2. Plan school and home-farm shops in accordance with the economic status of local agriculture.
3. Plan school and home-farm shops in accordance with functional requirements.
4. Select and purchase desirable equipment for school-farm shops.
5. Use basic shop equipment effectively.
6. Store shop equipment effectively.
7. Purchase and store shop supplies.
8. Design and apply adequate safety color system to the walls and equipment in school shops.
9. Maintain and repair shop equipment commonly found in farm mechanics shops.
10. Select shop work for instruction in accordance with economical practice and training value of each job.
11. Plan shop jobs to show cost, labor, and correct design.
12. Enforce the use of safety measures in school shops.
13. Apply first aid treatment in case of shop accidents.
14. Locate and use available resource materials.
15. Establish and follow desirable policies of public relations in the use and operation of school shops.
16. Maintain inventories of equipment and supplies.

B. Forge Work -- Ability to:

1. Build and maintain a satisfactory forge fire.
2. Measure and mark stock for various forging operations.
3. Heat stock for various forging operations.
4. Draw stock to desired shape.
5. Upset stock to desired shape.
6. Bend stock to dimensions.
7. Forge-weld steel.
8. Recondition plow shares.
9. Temper tool steel
10. Anneal hardened steel.
11. Cut hot stock to dimensions.

C. <u>Cold Metal Work</u> -- Ability to:

1. Measure and mark cold metal stock accurately.
2. Select correct hack saw blades and cut various kinds of metal.
3. Drill accurate holes to dimensions.
4. Select correct taps and cut inside threads.
5. Select correct dies and cut outside threads.
6. Reverse dies and clean-up damaged threads.
7. Bend cold stock to accurate dimensions.
8. Rivet metal together.
9. Select proper files and do various filing operations.

D. <u>Sheet Metal and Soldering</u> -- Ability to:

1. Measure, mark, and cut stock to dimensions.
2. Lay out radial patterns.
3. Bend sheet metal to dimensions.
4. Do simple forming operations.
5. Shape and tin soldering coppers.
6. Solder a lap seam.
7. Solder a hook seam.
8. Sweat on a patch.
9. Rivet sheet metal together.
10. Cut stove pipe or other similar surfaces.
11. Operate a blow torch.
12. Lay out various kinds of seams.

E. <u>Pipe Fitting</u> -- Ability to:

1. Select correct pipe size and type for a given job.
2. Compute required lengths of pipe for a given job and cut to dimensions.
3. Cut pipe threads properly.
4. Ream pipe to specificiations after being cut.
5. Select pipe fittings for a given job.
6. Assemble pipe and pipe fittings and tighten correctly.
7. Cut out damaged section of pipe from a fixed line and repair in place.
8. Prepare a standard bill of materials of pipe and pipe fittings for a given job and estimate cost.
9. Sweat copper pipe joints.

F. <u>Arc Welding</u> -- Ability to:

1. Select and purchase the most desirable arc welder for the school or home-farm shop.
2. Maintain and repair arc welder and accessories.
3. Assemble arc welding equipment and adjust current for welding.
4. Do satisfactory flat position welding.
5. Do satisfactory horizontal position welding.

6. Do satisfactory vertical position welding.
7. Do satisfactory overhead position welding.
8. Make satisfactory welds of various types, i.e., butt, lap, fillet, corner.
9. Do satisfactory brass welding with the carbon arc torch.
10. Apply hard surfacing material.
11. Cut metal and punch holes with the arc welder.
13. Weld cast iron.
14. Build up worn surfaces.
15. Practice and enforce safety measures in the use of arc welding equipment.
16. Recognize and analyze welding errors.

G. Oxy-Acetylene Welding -- Ability to:

1. Select and purchase the most desirable oxy-acetylene welding equipment for the school or home-farm shop.
2. Assemble oxy-acetylene equipment for various processes.
3. Adjust gages and flame for various processes.
4. Do satisfactory flat position welding.
5. Do satisfactory vertical position welding.
6. Do satisfactory overhead position welding.
7. Do satisfactory horizontal position welding.
8. Make satisfactory welds of various types, i.e., butt, lap, edge.
9. Do satisfactory brass welding.
10. Cut metal with the cutting torch.
11. Weld pipe satisfactorily.
12. Apply hard surfacting materials.
13. Fuse weld cast iron.
14. Apply hard solder (silver).
15. Test equipment for leaks or other defects.
16. Practice and enforce safety measures in all oxy-acetylene welding.
17. Identify various welding errors.

H. Rope Work - Ability to:

1. Select type and size of rope for a given need.
2. Store rope correctly.
3. Calculate strength and safe load for a given size of rope.
4. Tie common knots.
5. Make common loops.
6. Make common hitches.
7. Make long splice.
8. Make short splice.
9. Reeve a set of blocks.
10. Determine mechanical advantage in a given set of blocks.
11. Finish the ends of rope for permanence.
12. Make cattle halters.
13. Make casting tackle for various farm animals.

I. <u>Tool Care</u> -- Ability to:

1. Select correct grinder wheels for various uses.
2. True up grinder wheels.
3. Grind drill bits.
4. Grind cold chisels.
5. Dress up punches.
6. Install shop tool handles.
7. Repair, service, and maintain common tools and equipment found in school-farm shops.

APPENDIX

SUMMARY OF DATA RELATIVE

	Agricultural Engineers				Teacher Education Group				Teachers			
	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
A. General Principles												
1	8	3	0	95	10	2	0	110	31	8	2	350
2	9	2	0	100	9	3	0	105	26	15	0	335
3	9	2	0	100	11	1	0	115	31	10	0	360
4	10	1	0	105	12	0	0	120	32	9	0	365
5	10	1	0	105	11	1	0	115	38	2	1	390
6	6	4	1	80	10	2	0	110	30	8	3	340
7	7	4	0	90	10	1	1	105	30	8	3	340
8	6	4	1	80	7	4	1	90	15	24	2	270
9	7	4	0	90	11	1	0	115	35	6	0	380
10	8	3	0	95	11	1	0	115	30	11	0	355
11	7	4	0	90	12	0	0	120	29	11	1	345
12	11	0	0	110	11	1	0	115	38	2	1	390
13	10	1	0	105	11	1	0	115	30	10	1	350
14	9	2	0	100	10	2	0	110	32	9	0	365
15	7	4	0	90	10	1	1	105	32	9	0	365
16	7	4	0	90	10	2	0	110	29	11	1	345
Totals				1525				1775				5645
Percent		86.64				92.44				86.05		
Rank			3				3				3	

D

TO THE FARM SHOP AREA

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
41	1	0	415	90	14	2	970	21	20	0	310
36	6	0	390	80	26	0	930	20	19	2	295
36	5	1	385	87	18	1	960	18	22	1	290
36	6	0	390	90	16	0	980	12	20	9	220
40	2	0	410	99	6	1	1020	12	27	2	255
34	8	0	380	80	22	4	910	14	19	8	235
32	9	1	365	79	22	5	900	7	21	13	175
28	14	0	350	56	46	4	790	7	12	22	130
32	9	1	365	84	22	0	950	10	15	16	175
36	6	0	390	85	21	0	955	9	25	7	215
30	12	0	360	78	27	1	915	10	18	13	190
40	2	0	410	100	5	1	1025	21	15	5	285
36	5	1	385	87	17	2	955	7	11	23	125
27	13	2	335	78	26	2	910	12	23	6	235
33	7	2	365	82	21	3	925	13	15	13	205
31	8	3	350	77	25	4	895	10	13	18	165
			6045				14990				3505
89.95	1			88.22	2			53.43		6	

APPENDIX D

SUBAREA	Agricultural Engineers No. Essential	No. Moderate	No. None	Totals	Teacher Education Group No. Essential	No. Moderate	No. None	Totals	Teachers No. Essential	No. Moderate	No. None	Totals
B. Forge Work												
1	2	7	2	55	3	8	1	70	12	27	2	255
2	1	8	2	50	3	8	1	70	13	27	1	265
3	2	7	2	55	2	9	1	65	11	28	2	250
4	3	6	2	60	3	8	1	70	10	27	4	235
5	2	6	3	50	3	7	2	65	8	29	4	225
6	3	6	2	60	4	7	1	75	14	27	0	275
7	0	2	9	10	2	7	3	55	7	20	14	170
8	3	5	3	55	3	8	1	70	17	16	8	250
9	5	5	1	75	3	8	1	70	21	19	1	305
10	2	8	1	60	2	8	2	60	10	26	5	230
11	3	6	2	60	3	8	1	70	6	32	3	220
Total				590				740				2680
Percent	48.76				56.06				59.42			
Rank			9				9				9	

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
14	19	9	235	31	61	14	615	6	6	29	90
12	21	9	225	29	64	13	610	6	7	28	95
15	18	9	240	30	62	14	610	5	16	20	130
16	18	8	250	32	59	15	615	6	13	22	125
13	18	11	220	26	60	20	560	4	13	24	105
16	18	8	250	37	58	11	660	7	13	21	135
10	17	15	185	19	46	41	420	3	6	32	60
19	13	10	255	42	42	22	630	4	12	25	100
11	20	11	210	40	52	14	660	6	18	17	150
4	23	15	155	34	64	8	660	3	12	26	90
10	21	11	205	22	67	17	555	4	10	27	90
			2430				6595				1170
52.59				56.56				25.94			
		9				9				9	

SUBAREA	Agricultural Engineers				Teacher Education Group				Teachers			
	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
C. Cold Metal Work												
1	11	0	0	110	10	2	0	110	30	11	0	355
2	9	2	0	100	11	1	0	115	25	16	0	330
3	9	2	0	100	10	2	0	110	30	11	0	355
4	8	3	0	95	10	2	0	110	23	18	0	320
5	9	2	0	100	10	2	0	110	24	17	0	325
6	6	5	0	85	8	3	1	95	22	18	1	310
7	8	3	0	95	10	2	0	110	29	12	0	350
8	6	5	0	85	9	3	0	105	26	15	0	335
9	7	4	0	90	10	2	0	110	29	12	0	350
Total				860				975				3030
Percent	86.86				90.27				82.11			
Rank			2				4				4	

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
23	14	5	300	74	27	5	875	23	15	3	305
23	18	1	320	68	37	1	865	11	24	6	230
35	6	1	380	84	21	1	945	28	10	3	330
28	13	1	345	69	36	1	870	13	19	9	225
28	13	1	345	71	34	1	880	19	16	6	270
21	20	1	310	56	46	4	790	16	12	13	220
20	19	3	295	67	36	3	850	18	17	6	265
17	20	5	270	58	43	5	795	21	14	6	280
20	18	4	290	66	36	4	840	10	21	10	205
			2855				7710				2330
75.52		6		80.81		5		63.14		3	

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SUBAREA	Agricultural Engineers				Teacher Education Group				Teachers			
	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
D. Sheet Metal and Soldering												
1	9	2	0	100	9	2	1	100	31	10	0	360
2	5	6	0	80	4	7	1	75	15	25	1	275
3	7	4	0	90	9	2	1	100	23	18	0	320
4	6	5	0	85	7	4	1	90	22	16	3	300
5	8	3	0	95	8	4	0	100	33	7	1	365
6	6	5	0	85	8	4	0	100	30	10	1	350
7	6	5	0	85	6	6	0	90	31	9	1	355
8	6	5	0	85	8	4	0	100	32	8	1	360
9	6	5	0	85	8	4	0	100	28	11	2	335
10	3	6	2	60	6	6	0	90	18	22	1	290
11	8	3	0	95	9	2	1	100	29	12	0	350
12	3	6	2	60	4	8	0	80	20	21	0	305
Total				1005				1125				3965
Percent	76.13				78.12				80.58			
Rank			5				8				7	

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
20	18	4	290	69	32	5	850	26	14	1	330
13	21	8	235	37	59	10	665	16	19	6	255
13	25	4	255	52	49	5	765	18	21	2	285
16	23	3	275	51	48	7	750	16	21	4	265
20	15	7	275	61	37	8	795	30	11	0	355
18	21	3	285	64	39	3	835	28	12	1	340
17	20	5	270	60	40	6	800	29	12	0	350
18	20	4	280	64	37	5	825	28	13	0	345
15	24	3	270	57	44	5	790	22	14	5	290
14	24	4	260	41	58	7	700	5	10	26	100
22	19	1	315	68	36	2	860	14	10	17	190
12	26	4	250	39	61	6	695	14	22	5	250
64.68		8	3260	73.34		7	9330	68.19		1	3355

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SUBAREA	Agricultural Engineers No. Essential	No. Moderate	No. None	Totals	Teacher Education Group No. Essential	No. Moderate	No. None	Totals	Teachers No. Essential	No. Moderate	No. None	Totals
E. Pipe Fitting												
1	9	2	0	100	12	0	0	120	31	10	0	360
2	8	3	0	95	12	0	0	120	31	10	0	360
3	8	3	0	95	12	0	0	120	34	7	0	375
4	5	6	0	80	12	0	0	120	28	13	0	345
5	7	4	0	90	11	1	0	115	32	9	0	365
6	7	4	0	90	11	1	0	115	29	10	2	340
7	3	6	2	60	8	4	0	100	22	16	3	300
8	8	2	1	90	8	4	0	100	19	20	2	290
9	8	3	0	95	10	2	0	110	21	16	4	290
Total				795				1020				3025
Percent	80.30				94.44				81.97			
Rank			4				2				5	

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
26	15	1	335	78	27	1	915	14	17	10	225
22	19	1	315	73	32	1	890	19	16	6	270
29	13	0	355	83	23	0	945	24	13	4	305
22	16	4	300	67	35	4	845	21	14	6	280
29	12	1	350	79	26	1	920	14	16	11	220
28	13	1	345	75	28	3	890	17	16	8	250
25	13	4	315	58	39	9	775	3	11	27	85
15	22	5	260	50	48	8	740	4	13	24	105
26	14	2	330	65	35	6	825	0	7	34	35
			2905				7745				1775
76.85				81.18				48.10			
		5			4					8	

SUBAREA	Agricultural Engineers				Teacher Education Group				Teachers			
	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
F. Arc Welding												
1	8	3	0	95	10	2	0	110	29	12	0	350
2	4	5	2	65	8	2	2	90	22	16	3	300
3	9	2	0	100	11	1	0	115	36	3	2	375
4	11	0	0	110	12	0	0	120	38	3	0	395
5	8	3	0	95	10	2	0	110	36	5	0	385
6	5	6	0	80	9	3	0	105	32	7	2	355
7	2	5	4	45	7	4	1	90	19	20	2	290
8	10	1	0	105	11	1	0	115	37	4	0	390
9	1	9	1	55	8	3	1	95	18	19	4	275
10	6	4	1	80	8	4	0	100	32	9	0	365
11	5	5	1	75	10	2	0	110	30	10	1	350
12	1	7	3	45	5	7	0	85	16	23	2	275
13	3	8	0	70	9	2	1	100	32	9	0	365
14	6	5	0	85	9	3	0	105	34	7	0	375
15	10	1	0	105	12	0	0	120	40	1	0	405
16	10	1	0	105	12	0	0	120	39	2	0	400
Total				1315				1690				5650
Percent	74.71				88.02				86.12			
Rank			7				6				2	

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
37	5	0	395	84	22	0	950	22	15	4	295
23	16	3	310	57	39	10	765	10	12	19	160
39	3	0	405	95	9	2	995	29	10	2	340
36	6	0	390	97	9	0	1015	34	6	1	370
32	9	1	365	86	19	1	955	28	10	3	330
30	11	1	355	76	27	3	895	20	12	9	260
25	14	3	320	53	43	10	745	8	12	21	140
32	9	1	365	90	15	1	975	27	11	3	325
23	17	2	315	50	48	8	740	7	14	20	140
30	10	2	350	76	27	3	895	11	16	14	190
29	13	0	355	74	30	2	890	23	9	9	275
20	19	3	295	42	56	8	700	3	8	30	70
31	11	0	365	75	30	1	900	6	16	19	140
30	10	2	350	79	25	2	915	10	15	16	175
38	3	1	395	100	5	1	1025	28	10	3	330
36	6	0	390	97	9	0	1015	22	16	3	300
85.11			5720	84.75			14375	58.53			3840
		3			3				5		

SUBAREA	Agricultural Engineers No. Essential	No. Moderate	No. None	Totals	Teacher Education Group No. Essential	No. Moderate	No. None	Totals	Teachers No. Essential	No. Moderate	No. None	Totals
G. Oxy-Acetylene Welding												
1	9	2	0	100	9	3	0	105	29	12	0	350
2	8	3	0	95	12	0	0	120	38	3	0	395
3	8	3	0	95	12	0	0	120	39	2	0	400
4	9	2	0	100	12	0	0	120	37	4	0	390
5	5	6	0	80	9	3	0	105	15	7	19	185
6	1	7	3	45	7	4	1	90	9	27	5	225
7	6	5	0	85	10	2	0	110	25	15	1	325
8	7	4	0	90	12	0	0	120	36	5	0	385
9	6	5	0	85	7	5	0	95	31	7	3	345
10	7	4	0	90	12	0	0	120	38	3	0	395
11	3	5	3	55	9	3	0	105	23	17	1	315
12	5	6	0	80	9	3	0	105	30	9	2	345
13	4	4	3	60	8	2	2	90	17	20	4	270
14	1	8	2	50	5	5	2	75	9	23	9	205
15	7	3	1	85	9	3	0	105	23	15	3	305
16	10	1	0	105	12	0	0	120	41	0	0	410
17	9	2	0	100	12	0	0	120	39	2	0	400
Total				1400				1825				5645
Percent	74.86				89.46				80.98			
Rank			6				5				6	

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
35	7	0	385	82	24	0	940	11	19	11	205
32	9	1	365	90	15	1	975	21	19	1	305
34	7	1	375	93	12	1	990	30	10	1	350
29	12	1	350	87	18	1	960	30	9	2	345
23	18	1	320	52	34	20	690	9	9	23	135
18	21	3	285	35	59	12	645	2	9	30	65
23	18	1	320	64	40	2	840	15	16	10	230
29	12	1	350	84	21	1	945	25	14	2	320
21	19	2	305	65	36	5	830	18	13	10	245
28	13	1	345	85	20	1	950	30	9	2	345
18	23	1	295	53	48	5	770	6	13	22	125
23	15	4	305	67	33	6	835	10	13	18	165
23	15	4	305	52	41	13	725	6	9	26	105
17	16	9	250	32	52	22	580	1	4	36	30
28	13	1	345	67	34	5	840	8	11	22	135
38	3	1	395	101	4	1	1030	26	12	3	320
32	9	1	365	92	13	1	985	22	15	4	295
			5660				14530				3720
79.27				80.63				53.37			
	4					6				7	

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APPENDIX D

SUBAREA	Agricultural Engineers				Teacher Education Group				Teachers			
	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
H. Rope Work												
1	4	7	0	75	10	2	0	110	23	17	1	315
2	6	2	3	70	9	3	0	105	22	19	0	315
3	5	4	2	70	8	4	0	100	19	21	1	295
4	5	6	0	80	8	4	0	100	30	11	0	355
5	4	6	1	70	6	5	1	85	25	16	0	330
6	4	7	0	75	8	3	1	95	26	15	0	335
7	3	8	0	70	8	4	0	100	27	14	0	340
8	3	8	0	70	7	5	0	95	27	14	0	340
9	3	7	1	65	8	2	2	90	13	24	4	250
10	7	3	1	85	5	7	0	85	12	25	4	245
11	5	6	0	80	9	3	0	105	30	11	0	355
12	2	8	1	60	6	6	0	90	23	18	0	320
13	3	5	3	55	9	2	1	100	12	27	2	255
Total				925				1260				4050
Percent				64.68				80.76				75.98
Rank				8				7				8

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
17	22	3	280	54	48	4	780	20	16	5	280
16	22	4	270	53	46	7	760	20	16	5	280
19	20	3	290	51	49	6	755	16	8	17	200
22	18	2	310	65	39	2	845	26	11	4	315
15	24	3	270	50	51	5	755	25	13	3	315
15	24	3	270	53	49	4	775	23	15	3	305
15	22	5	260	53	48	5	770	25	14	2	320
16	23	3	275	53	50	3	780	25	13	3	315
15	25	2	275	39	58	9	680	8	9	24	125
14	26	2	270	38	61	7	685	18	9	14	225
20	19	3	295	64	39	3	835	31	8	2	350
21	20	1	310	52	52	2	780	24	10	7	290
18	21	3	285	42	55	9	695	8	13	20	145
67.03		7	3660	71.80		8	9895	65.0		2	3465

APPENDIX D

SUBAREA	Agricultural Engineers				Teacher Education Group				Teachers			
	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
I. Tool Care												
1	8	3	0	95	12	0	0	120	28	13	0	345
2	8	3	0	95	11	1	0	115	29	12	0	350
3	9	2	0	100	12	0	0	120	35	6	0	380
4	9	2	0	100	12	0	0	120	33	8	0	370
5	9	1	1	95	12	0	0	120	33	7	1	365
6	7	4	0	90	11	1	0	115	32	8	1	360
7	9	2	0	100	12	0	0	120	37	4	0	390
Total				675				830				2560
Percent		87.66				98.80				89.30		
Rank			1				1				1	
GRAND TOTAL				9090				11240				36250
PERCENT		75.12				84.69				80.37		

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
32	10	0	370	80	26	0	930	9	17	15	175
29	11	2	345	77	27	2	905	11	14	16	180
35	7	0	385	91	15	0	985	21	17	3	295
30	12	0	360	84	22	0	950	25	14	2	320
28	14	0	350	82	22	2	930	23	14	4	300
30	12	0	360	80	25	1	925	15	16	10	230
35	6	1	380	93	12	1	990	12	17	12	205
			2550				6615				1705
86.73		2			89.15	1			59.40	4	
			35085				91785				24865
	75.94				78.71				55.13		

APPENDIX E

List of Farm-Structures Abilities Included in the Study

Area: <u>Farm Buildings and Structures</u>

A. <u>General Principles</u> -- Ability to:

1. Plan farm structures according to sound principles of economics.
2. Plan structures according to functional requirements of various agricultural enterprises.
3. Estimate size, capacity and cost of farm structures.
4. Select most desirable building materials.
5. Make simple drawings of farm structures.
6. Read and interpret blue prints.
7. Plan the location of buildings in relation to the farmstead.
8. Prepare a standard bill of materials.
9. Design or select joists and beams for strength.
10. Design the insulation and ventilation plans for structures according to requirements of various agricultural enterprises.
11. Locate and use Building Manufacturers "Plans Services".

B. <u>Use and Care of Carpentry Tools and Equipment</u> -- Ability to:

1. Select and purchase carpentry tools according to accepted standards.
2. Use basic carpentry tools correctly.
3. Sharpen, adjust, maintain, and repair carpentry tools.
4. Select and purchase power woodworking equipment for the school and farm shop.
5. Operate power woodworking equipment correctly.
6. Maintain and repair power woodworking equipment.
7. Store carpentry tools effectively.
8. Place shop equipment in best location for safety and efficiency.
9. Apply principles of safety in the use of tools and power equipment.

C. <u>Construction of Farm Buildings</u> -- Ability to:

1. Measure, mark, and cut materials to specified dimensions.
2. Drive various kinds of nails.
3. Use wood connectors and fasteners.
4. Lay out foundation lines and set grade stakes for buildings.

5. Place or pour footings for various structures.
6. Calculate dimensions, cut, and erect framing.
7. Calculate dimensions, cut, and erect common rafters.
8. Apply roofing.
9. Cut and apply sheathing and siding.
10. Cut and install insulation material.
11. Calculate dimensions, construct, and erect stairways.
12. Cut and apply material for interior and exterior walls.

D. Related Woodworking -- Ability to:

1. Construct common wood joints.
2. Select and use wood glue.
3. Use wood dowels.
4. Drill holes in lumber.
5. Construct kitchen cabinets.
6. Make small articles of furniture.
7. Repair furniture.
8. Install door locks.
9. Cut and install linoleum, and floor tile.
10. Construct ordinary wood projects for farm use, i.e., trailer box, feed bunker, poultry feeder, etc.

E. Painting and Glazing -- Ability to:

1. Select house paint and other wood finishes according to requirements.
2. Mix and/or tint paint according to requirements.
3. Prepare surfaces for painting.
4. Select proper paint brushes and apply paint, varnish, shellac, and enamel.
5. Clean and store paint brushes.
6. Apply paint with paint sprayer.
7. Select, mix, and apply wood stains.
8. Treat lumber with preservatives.
9. Select and apply proper masonry paint.
10. Measure, cut, and install glass.
11. Refinish furniture.
12. Select and apply metal paint to farm machinery, roofing, etc.

F. Concrete and Masonry -- Ability to:

1. Estimate quantities and costs of concrete and masonry materials needed for a given structure.
2. Select aggregates for making concrete and test for quality.
3. Select masonry blocks and determine quality.
4. Construct forms needed in building various concrete structures common to the farm.
5. Mix, place, and finish concrete.

6. Select and apply paint, coloring, and waterproofing materials to concrete and masonry.
7. Prepare mortar for concrete masonry.
8. Lay concrete masonry according to standards of construction.
9. Repair or patch broken concrete.

G. <u>Repair of Farm Structures</u> -- Ability to:

1. Determine need for repairs and estimate costs of given job.
2. Repair foundations.
3. Repair roofs.
4. Repair windows and doors.
5. Repair floors.
6. Repair fences and gates.
7. Repair farm equipment made of wood.

APPENDIX F

SUMMARY OF THE DATA RELATIVE

SUBAREA	Agricultural Engineers				Teacher Education Grp.				Teachers			
	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
A. General Principles												
1	10	4	0	120	9	5	0	115	21	18	0	300
2	12	2	0	130	11	3	0	125	27	12	0	330
3	7	5	2	95	13	1	0	135	26	13	0	325
4	8	6	0	110	13	1	0	135	24	15	0	315
5	10	4	0	120	11	3	0	125	29	9	1	335
6	10	4	0	120	12	2	0	130	17	20	2	270
7	10	3	1	115	9	5	0	115	23	14	2	300
8	9	4	1	110	14	0	0	140	30	8	1	340
9	3	8	3	70	6	7	1	95	9	24	6	210
10	3	9	2	75	10	3	1	115	13	25	1	255
11	11	3	0	125	6	8	0	100	14	22	3	250
Total				1190				1330				3230
Percent	77.27				86.36				75.29			
Rank			2				4				4	
B. Use and Care of Tools												
1	10	4	0	120	12	2	0	130	26	11	2	315
2	12	2	0	130	14	0	0	140	36	3	0	375
3	12	2	0	130	14	0	0	140	37	2	0	380
4	10	4	0	120	10	4	0	120	25	11	3	305
5	10	4	0	120	13	1	0	135	31	8	0	350

TO THE FARM STRUCTURES AREA

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
32	9	1	365	72	36	1	900	1	26	12	140
32	10	0	370	82	27	0	955	5	21	13	155
21	19	2	305	67	38	4	860	7	20	12	170
20	19	3	295	65	41	3	855	7	22	10	180
23	15	4	305	73	31	5	885	17	13	9	235
18	20	4	280	57	46	6	800	12	19	8	215
25	15	2	325	67	37	5	855	9	19	11	185
10	25	7	225	63	37	9	815	15	15	9	225
19	16	7	270	37	55	17	645	2	15	22	95
20	18	4	290	46	55	8	735	2	24	13	140
16	22	4	270	47	55	7	745	4	10	25	90
71.42			3300	75.47			9050	42.65			1830
		2				3				3	
20	18	4	290	68	35	6	855	10	18	11	190
34	8	0	380	96	13	0	1025	10	24	5	220
29	10	3	340	92	14	3	990	10	21	8	205
29	11	2	345	74	30	5	890	4	16	19	120
35	6	1	380	89	19	1	985	8	19	12	175

APPENDIX F

SUBAREA	Agricultural Engineers				Teacher Education Grp.				Teachers			
	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
B. Use and Care of Tools (Cont.)												
6	5	9	0	95	5	9	0	95	18	19	2	275
7	8	5	1	105	9	5	0	115	28	11	0	335
8	11	3	0	125	11	3	0	125	31	8	0	350
9	13	1	0	135	14	0	0	140	36	3	0	375
Total				1080				1140				3060
Percent	85.71				90.47				87.17			
Rank			1				1				1	
C. Construction of Farm Buildings												
1	13	1	0	135	14	0	0	140	34	5	0	365
2	9	4	1	110	11	3	0	125	24	14	1	310
3	6	8	0	100	11	3	0	125	18	20	1	280
4	10	4	0	120	11	3	0	125	27	12	0	330
5	6	8	0	100	11	3	0	125	26	13	0	325
6	8	6	0	110	13	1	0	135	27	12	0	330
7	8	6	0	110	13	1	0	135	30	9	0	345
8	5	9	0	95	10	4	0	120	19	19	1	285
9	4	9	1	85	10	4	0	120	12	25	2	245
10	4	9	1	85	10	4	0	110	18	19	2	275
11	3	11	0	85	6	6	2	90	6	26	7	190
12	2	11	1	75	9	4	1	110	5	24	10	170
Total				1210				1460				3450
Percent		72.02				86.90				73.71		
Rank			4				3				5	

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
20	18	4	290	48	55	6	755	2	13	24	85
27	13	2	335	72	34	3	890	13	13	13	195
35	7	0	385	88	21	0	985	17	14	8	240
40	2	0	410	103	6	0	1060	15	18	6	240
			3155				8435				1670
83.46				85.98				47.57			
		1				1				1	

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
31	11	0	365	92	17	0	1005	21	14	4	280
18	18	6	270	62	39	8	815	18	11	10	235
16	22	4	270	51	53	5	775	6	22	11	170
24	16	2	320	72	35	2	895	10	13	16	165
21	20	1	310	64	44	1	860	10	14	15	170
21	17	4	295	69	36	4	870	11	17	11	195
23	15	4	305	74	31	4	895	14	19	6	235
16	19	7	255	50	51	8	755	6	12	21	120
10	29	3	245	42	61	6	725	8	9	22	125
8	27	7	215	32	67	10	655	6	9	24	105
9	24	9	210	24	67	18	575	4	12	23	100
8	26	8	210	24	65	20	565	2	8	29	60
			3270				9390				1960
64.88				71.79				41.88			
		6				5				4	

APPENDIX F

SUBAREA	Agricultural Engineers No. Essential	No. Moderate	No. None	Totals	Teacher Education Grp. No. Essential	No. Moderate	No. None	Totals	Teachers No. Essential	No. Moderate	No. None	Totals
D. Related Woodworking												
1	8	4	2	100	4	9	1	85	13	23	3	245
2	4	9	1	85	0	14	0	70	14	23	2	255
3	2	7	5	55	0	11	3	55	9	22	8	200
4	8	4	2	100	10	4	0	120	21	18	0	300
5	1	7	6	45	0	7	7	35	7	18	14	160
6	0	7	7	35	0	4	10	20	9	16	14	170
7	2	6	6	50	2	8	4	60	8	21	10	185
8	2	11	1	75	3	9	2	75	11	21	7	215
9	1	11	2	65	4	10	0	90	5	20	14	150
10	12	1	1	125	12	2	0	130	37	2	0	380
Total				735				740				2260
Percent	52.50				52.85				57.94			
Rank			7				7				7	
E. Painting and Glazing												
1	9	4	1	110	11	3	0	125	22	17	0	305
2	4	7	3	75	6	8	0	100	7	22	10	180
3	11	3	0	125	13	1	0	135	23	15	1	305
4	6	8	0	100	11	3	0	125	23	16	0	310
5	8	6	0	110	11	3	0	125	27	11	1	325
6	4	7	3	75	7	7	0	105	21	17	1	295
7	3	7	4	65	2	9	3	65	9	23	7	205

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
21	18	3	300	46	54	9	730	3	19	17	125
15	22	5	260	33	68	8	670	3	11	25	85
17	20	5	270	28	60	21	580	1	10	28	60
16	20	6	260	55	46	8	780	15	15	9	225
8	20	14	180	16	52	41	420	2	6	31	50
8	23	11	195	17	50	42	420	3	6	30	60
8	24	10	200	20	59	30	495	0	7	32	35
9	27	6	225	25	68	16	590	2	2	35	30
5	24	13	170	15	65	219	475	1	4	34	30
32	9	1	365	93	14	2	1000	8	17	14	165
			2425				6160				865
57.53		7		56.51		7		22.17		6	

22	17	3	305	64	41	4	845	5	21	13	155
11	22	9	220	28	59	22	575	4	12	23	100
23	16	3	310	70	35	4	875	7	16	16	150
20	18	4	290	60	45	4	825	6	15	18	135
20	20	2	300	66	40	3	860	5	15	19	125
15	24	3	270	47	55	7	745	1	5	33	35
12	24	6	240	26	63	20	575	1	11	27	65

APPENDIX F

SUBAREA	Agricultural Engineers No. Essential	No. Moderate	No. None	Totals	Teacher Education Group No. Essential	No. Moderate	No. None	Totals	Teachers No. Essential	No. Moderate	No. None	Totals
E. Painting and Glazing (Cont.)												
8	4	9	1	85	7	6	1	100	24	15	0	315
9	6	8	0	100	8	6	0	110	18	20	1	280
10	5	8	1	90	10	4	0	120	21	18	0	300
11	1	7	6	45	1	5	8	35	8	18	13	170
12	8	5	1	105	12	1	1	125	32	6	1	350
Total				1085				1270				3340
Percent	64.58				75.59				71.36			
Rank			6				6				6	
F. Concrete and Masonry												
1	9	5	0	115	12	2	0	130	25	14	0	320
2	8	6	0	110	12	2	0	130	23	16	0	310
3	4	8	2	80	8	6	0	110	21	15	3	285
4	8	6	0	110	11	3	0	125	26	13	0	325
5	14	0	0	140	12	2	0	130	32	6	1	350
6	4	8	2	80	9	5	0	115	22	6	11	250
7	11	3	0	125	12	2	0	130	26	13	0	325
8	4	10	0	90	10	4	0	120	25	13	1	315
9	8	5	1	105	9	5	0	115	21	18	0	300
Total				955				1105				2780
Percent	75.79				87.69				79.20			
Rank			3				2				3	

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
24	15	3	315	59	45	5	815	1	11	27	65
21	18	3	300	53	52	4	790	1	11	27	65
15	20	7	250	51	50	8	760	6	13	20	125
6	22	14	170	16	52	41	420	0	8	31	40
26	16	0	340	78	28	3	920	3	10	26	80
			3310				9005				1140
65.67				68.84				24.35			
	5					6				5	
22	20	0	320	68	41	0	885	18	13	8	245
16	22	4	270	59	46	4	820	19	14	6	260
14	27	1	275	47	56	6	750	11	15	13	185
24	17	1	325	69	39	1	885	8	19	12	175
23	18	1	320	61	46	2	840	10	21	8	205
18	19	5	275	63	38	8	820	1	12	26	70
20	19	3	295	69	37	3	875	10	16	13	180
10	32	0	260	49	59	1	785	11	15	13	185
16	22	4	270	54	50	5	790	1	11	27	65
			2610				7450				1570
69.04				75.94				44.72			
	4					2				2	

SUBAREA	Agricultural Engineers				Teacher Education Group				Teachers			
	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
G. Repair of Farm Structures												
1	10	3	1	115	10	4	0	120	25	14	0	320
2	5	8	1	90	6	7	1	95	23	16	0	310
3	8	4	2	100	7	6	1	100	26	13	0	325
4	6	7	1	95	8	6	0	110	24	15	0	315
5	6	5	3	85	8	6	0	110	21	18	0	300
6	8	5	1	105	8	6	0	110	28	11	0	335
7	7	5	2	95	8	6	0	110	25	12	2	310
Total				685				755				2215
Percent	69.89				77.04				81.13			
Rank			5				5				2	
GRAND TOTAL				6940				7800				20335
Percent	70.81				79.59				74.48			

(Continued)

Farmers				Composite Sample				Teacher's Training			
No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals	No. Essential	No. Moderate	No. None	Totals
24	15	3	315	69	36	4	870	3	16	20	110
22	18	2	310	56	49	4	805	0	9	30	45
22	15	5	295	63	38	8	820	2	9	28	65
19	18	5	280	57	46	6	800	3	12	24	90
18	19	5	275	53	48	8	770	2	7	30	55
25	13	4	315	69	35	5	865	5	9	25	95
20	17	5	285	60	40	9	800	5	15	19	125
			2075				5730				585
70.60				75.09				21.42			
		3				4				7	
			20145				55220				9620
68.52				72.37				35.23			