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The Technical Abilities and Manipulative Skills Which Should be Taught in a High School Vocational Agriculture Farm Mechanics Program in South Dakota

Charles O. Stormo

THE TECHNICAL ABILITIES AND MANIPULATIVE SKILLS WHICH SHOULD BE TAUGHT IN A HIGH SCHOOL VOCATIONAL AGRICULTURE FARM MECHANICS PROGRAM IN SOUTH DAKOTA

BY

CHARLES O. STORMO

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This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and acceptable as meeting the thesis requirements for this degree; but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Advisor

Head of the Major Department

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SECTION I

INTRODUCTION

The typical high school vocational agriculture teacher experiences a lack of time necessary to teach all of the technical abilities and manipulative skills that have become a part of the farm mechanics program. He may spend time teaching outdated abilities when his time could be more profitably used in teaching the abilities that are required in modern mechanized farming. Perhaps some time should also be applied to anticipating and developing those abilities required to do jobs which are now commonly referred to specialists but may be required of the student when he becomes established in farming several years hence. An example of such an ability is the adjustment of power machinery and the replacement of gears and bearings on field machinery. Some jobs like the cleaning and repair of electric motors, which are commonly referred to specialists at the present time, will likely be done on the farms by farmers 10 or 15 years hence. The term ability as used in this research is interpreted to mean technical understandings and shop manipulative skills which are, or might soon be, an integral part of mechanized farming.

A bulletin published by the United States Department of Health, Education and Welfare points out that there has been more progress in farm mechanics during the past 25

years than during the previous 5,000.[1] Recent research in the field of farm mechanics in other states has indicated that teaching farm mechanics abilities has lagged about five years. Considering the fact that the student is not usually well established in farming until about five years after graduation from high school, one finds that some of the skills learned in high school will be about ten years out-of-date by the time the student becomes an established farmer. This fallacy of teaching outdated abilities seems even more serious when the importance of such occupational competencies is considered.

The importance of good farm mechanics training in the successful operation of a farm business is pointed out by Bradley[2]. In his research he surveyed the farmers of his home community and classified them as successful farmers, marginal farmers, and farmers who worked off their farms to help support their operations. He found that all of the successful farmers had farm shops that rated excellent to good. The marginal farm shops rated poor, and shops of those classified as part-time farmers rated poor to no shop

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[1]A. H. Hollenberg, Instruction in Farm Mechanics, U. S. Department of Health, Education and Welfare Vocational Division Bulletin Number 267, Agricultural Series Number 70, p. 1, U. S. Government Printing Office, Washington, D. C., 1957.

[2]Harry H. Bradley, "Are We Teaching Farm Mechanics?" The Agricultural Education Magazine, Vol. 33, 158-159, The Interstate, Danville, Illinois, January, 1961.

at all. The successful farmers did most of their own shop work on the farm, including maintenance, complete overhauling of engines and equipment, and the constructing of new equipment and farm buildings. The mechanical work done by the second group of farmers consisted mainly of maintenance, while the last group did very little maintenance or repairing of their own farm machinery and equipment. This was not intended to imply that to be a successful farmer one must do all his own shop work, but it seemed to indicate a relationship between shop skills and successful farm operation.

This relationship is increasingly apparent in modern times because the farm investment in machinery is often 50 per cent or more of the total farm value. The survey showed that, in many cases, the marginal farmer had a much higher inventory of machinery than the successful farmer. This was due to the amount of equipment that had replaced other equipment which was no longer usable. This shows either the lack of mechanical ability to repair and construct equipment at a savings or the lack of managerial ability to make appropriate decisions concerning replacement or repair of equipment.

The final part of the survey showed that the highly successful group of farmers had received previous preparation from vocational agriculture or from practical experience. The farm operators in the part-time group had no farm mechanics training. Thus, it seems very important for teachers

of vocational agriculture to arrange teaching content to include those skills which will be important to the student when he becomes established in his chosen occupation.

Perhaps the only true solution to the problem of developing a curriculum that includes abilities usable five or ten years hence would be to acquire insight into the future. However, since there is no hope of accurately achieving such insight, the logical alternative would be to bring teaching units up-to-date and, by constant revision, to keep them up-to-date. Some abilities, which are still considered to be in the realm of the specialist, might be explored in anticipation of their becoming common abilities of the farmer within the next few years. If such revision can be accomplished, it would offer at least a partial solution to the problem. In an attempt to establish a revised list of abilities to be learned by the farm mechanics student, the writer decided to undertake this research.

In this research selected farmers indicated when they had learned various abilities related to farm mechanics, how often they used the abilities and how important it is that they be included in the farm mechanics teaching plan of the vocational agriculture teacher. The abilities used by farmers will vary from one farming area to another. For that reason the implications of this research are intended to be adaptable to South Dakota and similar areas with adjustments to meet specific requirements of local situations.

SECTION II

PURPOSE

As farming becomes more mechanized, the need for effective teaching in farm mechanics becomes more obvious. The purpose of this research is to point out the need for bringing the farm mechanics program up-to-date and to suggest revised curriculum content for teaching farm mechanics in South Dakota. Typical questions which must be answered in determining the kind of farm mechanics program to conduct are: What are the reasons for including farm mechanics as a part of the training in vocational agriculture? What training in farm mechanics is considered necessary by present farmers? Such questions prompted the writer to undertake this research which is aimed toward improving the vocational agriculture curriculum in agricultural mechanics.

The writer has learned from teaching experience that some school administrators, community leaders, and vocational agriculture teachers feel that a desirable objective would be to construct as many articles in the farm shop as possible, to construct big projects, to learn to build and finish living room and bedroom furniture, or to learn a related trade. No fault is to be found with large projects. However, such projects encourage the use of, and necessity for, production type equipment such as belt sanders and lathes in the school's farm mechanics shop which will not

be available to the student when he is farming. Also, shop projects which are attempted prior to the student's learning of related basic skills may encourage carelessness and poor workmanship. The most defensible aim in farm mechanics instruction is, "To teach students the abilities, skills, attitudes, and understandings needed to operate and manage a farming operation."[3]

This research purports to determine which abilities are used by former vocational agriculture students who are now established in farming, when such abilities were developed, and how important such abilities are regarded by these farmers. Using the information gained from this research, the writer presents a revised curriculum in farm mechanics.

The revision of teaching content implied by this work is aimed primarily toward the all day portion of the vocational agriculture program. Teaching content of young farmer and adult farmer classes usually centers around current needs of the farmers. Thus abilities learned can be applied immediately and there is less need for anticipating future needs of the students.

This research can also be of value to persons other than future vocational agriculture students. It can help

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[3]C. V. Roderick, "Whither Farm Mechanics?", The Agricultural Education Magazine, Vol. 33, 147-148, The Interstate, Danville, Illinois, January, 1961.

the writer and other vocational agriculture teachers in organizing teaching materials for maximum effectiveness. It has, in addition, some implications for improving the mechanized agriculture curriculum in the pre-service and in service training of vocational agriculture teachers.

SECTION III

METHODS OF INVESTIGATION

Those persons who were awarded the South Dakota Farmer Degree during the years 1945 through 1955 are well qualified to indicate which abilities are important in the present day farm mechanics curriculum. They were among the top students in their high school classes and were very active in the vocational agriculture program or they would not have been awarded the South Dakota Farmer Degree. The type of persons capable of earning such recognition, who studied vocational agriculture as part of their high school preparation and are now farming, were willing to give carefully considered answers to questions which help to improve the present and future vocational agriculture program. It is not intended to imply that we should determine the content of farm mechanics curriculum purely on the basis of farmers' opinions. However, in farm mechanics curriculum development, farmers were found to consider less abilities as essential than did vocational agriculture teachers, agricultural education staff members or specialists in agricultural engineering.[4] Since this research deals

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[4]Gordon J. Ryder, "Skills Needed by Farmers in Selected Areas of Farm Mechanics," p. 59, Summaries of Studies in Agricultural Education, Vocational Education Bulletin 283, Supplement Number 7, Study Number 1817, 1953.

primarily with curriculum revision rather than curriculum development, it was decided the opinions of farmers would be used in formulating conclusions and recommendations.

To get reliable responses from a desirable cross section of farmers, the writer sought replies from at least 100 farmers who had received the South Dakota Farmer Degree while they were in high school. In an attempt to get final responses from at least 100 farmers, the writer decided to start with a group of about 300 persons. Therefore, it was necessary to have a list of State Farmer Degree recipients from about 11 years. Graduates of the years 1945-1955 were chosen because most of them who were planning to farm would most likely have become established in farming by this time. A list of those persons was obtained from Mr. Harold Urton, State Supervisor of Vocational Agriculture, and their present addresses were obtained from the present vocational agriculture teachers or superintendents in the schools from which the degree recipients graduated. The names and addresses of 295 persons were received. Each was sent a questionnaire (Appendix E) with a letter (Appendix D) explaining the nature of the research.

The questionnaire listed 170 abilities. There were 54 abilities related to farm shopwork, 32 related to farm power and machinery, 32 related to buildings and other structures, 27 related to farm electrification and 25 related to soil and water management as it applies to farm mechanics.

In selecting abilities to be included in the questionnaire (Appendix E), the writer compiled a comprehensive list from farm mechanics texts and research papers. From this list, all duplications were eliminated and items were selected from all areas in an attempt to cover the entire field with as few representative items as possible.

When the questionnaires were returned, they were separated according to the first six year period or the last five year period in which the respondents graduated. Since no significant difference was found when the responses from the graduates from the first six years were compared with other responses, only the total responses to each item were used. All responses received from the farmers were then tabulated on a chart. When the tabulation was completed, completed questionnaires had been received from 221 respondents. Of the 221 respondents, 129 were farming.

The responses to each item in the questionnaire were evaluated by the Chi-square method to determine the level of confidence at which the responses could be considered. Responses that were not significant at the two per cent level of confidence were eliminated from further consideration. The remaining items were grouped according to their importance in the farm mechanics program as expressed by the respondents. The items were also arranged in tables, according to their importance, in each of the five areas of farm mechanics as disclosed in Section V.

Some respondents did not answer all items on the questionnaire. Therefore, since the raw scores were not readily comparable in all cases, they were changed to the per cent of scores for each item. In all comparisons and tables, percentage scores were rounded to the nearest tenth of one per cent.

SECTION IV

REVIEW OF LITERATURE

The teaching of vocational agriculture in the public schools of the United States was brought about by the development of the provisions set forth in the National Vocational Education Act of 1917. The purpose of this program as provided by that legislation is to train present and prospective farmers for proficiency in farming. In the early development of the curriculum, courses in mechanized agriculture were not considered to be as important as other technical agriculture courses. However, farming operations of today are becoming increasingly more mechanized and complex. Larson[5] in his recent research in South Dakota stated, "A great share of the responsibility for better farm equipment maintenance and repair falls directly to the teaching personnel in vocational agriculture."

Struck[6] explained both the long range and immediate objectives of teaching farm mechanics as follows:

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[5]Marvin E. Larson, A Study to Determine the Technical Abilities Needed in the Farm Mechanics Curriculum of Agriculture Education Majors in Pre-Service Training, p. 7, Master's Degree Thesis, Department of Agricultural Education, South Dakota State College, Brookings, 1958.

[6]Theodore Struck, Farm Shop Work in Pennsylvania, p. 2, The Pennsylvania State College, School of Agriculture, Rural Life Department, Special Bulletin Number 1, May, 1930.

> The aim or purpose to be kept in mind in teaching farm shop work may be stated in this way: It is the self-realization through individual purposing, planning and doing the kinds of repair and construction work that successful farmers of the region engage in. By self-realization is meant the development of one's best self in ways that promote and perpetuate the ideals and best interest of society.
>
> When it is said that the purpose of farm shop work is to give manual skill, accuracy of eye or a knowledge of tool processes, only part of the story is told. All these enter into farm shop work but they are only means to ends instead of ends in themselves. To be sure, farm shop work as part of vocational agricultural education must make a demonstrable contribution to vocational efficiency. If the instruction does not lead to economic production--to more prosperous agriculture--it fails in a vital way, but educationally it is important to think of the boy as the chief product of farm shop work instruction, and of the work performed merely as perhaps the best single, tangible evidence of his vocational development. Now this does not mean that good standards of workmanship are not essential. It means that through the application of certain well-recognized laws of psychology and of pedagogy better material and social results can be secured through major emphasis on the individual pupil as a developing democratic citizen than can possibly be obtained through narrow vocational training the purpose of which is habit formation, as distinguished from vocational education the purpose of which is habit formation plus individual purposing and reasoning.

Phipps and Cook[7] emphasized the importance of maintenance and repair in farm mechanics in the following statements:

> Most of the farm mechanics activities of farmers concern the maintenance, repair, and adjustment of farm machinery. The repair and maintenance of farm buildings is often of more importance than the construction of new buildings. An appreciation of the economy involved in

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[7]Lloyd J. Phipps and Glen C. Cook, A Handbook on Teaching Vocational Agriculture, p. 700, The Interstate, Danville, Illinois, 1952.

> the proper maintenance of farm machinery and buildings is vital to the efficient operation of a farm.

A farmer operating machinery must know how to replace broken and worn parts, put the machine back together, and properly adjust it. Most farmers do not have the tools to do major repair work on a tractor, but they should be able to do minor repairs.

Phipps and Cook[8] also express their opinion regarding undesirable content of farm mechanics courses:

> Often abilities are developed in farm mechanics courses which do not belong in farm mechanics: for example, teaching regarding the operation of metal lathes, and jointers commonly used in industrial shops, and teaching regarding the construction and finishing of furniture commonly taught in manual arts courses. Content for farm mechanics should contribute to the students' proficiency in farming. Since the mechanical abilities necessary for farming are so numerous that all cannot be taught anyway, any content of doubtful value on farms should be eliminated from the courses in vocational agriculture.
>
> The farm mechanics program is an educational program and not a factory for the manufacture of products. When a shop project produces something in volume, it soon loses its value as a part of an educational program and becomes merely a work program. Some departments drift into mass production as a money-making activity. It may be alright to construct one feeder for sale. If more than one is produced, the project is probably rapidly approaching the point of diminishing educational returns.

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[8] Ibid., p. 700.

Phipps and Deyoe[9] found that farmers indicated little interest in becoming experts in various semi-skilled areas such as plumbing, electrical work, blacksmithing, and construction of large buildings. Also, little interest was shown in rope work, soldering, and painting.

Welker's[10] study indicated that there was a poor carryover of farm mechanics to the home farm in Montana as well as in other states. He felt that some of the reasons for the lack of carryover were:

1. Lack of definite course planning that will attain carryover
2. A meager home farm shop supervised practice program
3. Types of farm shop work done at home are not the same as those emphasized in the school shop
4. Students bring relatively few jobs from home to do in school
5. A small amount of home farm shop supervision

In summarizing the results of Welker's study, a number of other conclusions were noted:

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[9]Lloyd J. Phipps and George P. Deyoe, "Determing Farm Mechanics Content -- What Farmers Consider Important", Non-thesis study in Illinois, Summaries of Studies in Agricultural Education, p. 54, Vocational Education Bulletin Number 253, Supplement Number 7, Study Number 1807, 1952.

[10]William Joseph Welker, The Montana Farm Mechanics Program in Vocational Agriculture, p. 47, Master's Thesis, Montana State College, Bozeman, 1941.

1. Very few instructors have written courses of study
2. Students do free work for school patrons - do not bring jobs from home
3. Farm shop instruction is given to less than 50 per cent of the seniors
4. Tools on farms are adequate but buildings are inadequate
5. Vocational agriculture shop programs fail to conform to the needs of the students
6. Instructors recognize that their college training did not adequately prepare them to teach farm shop

On the basis of the foregoing conclusions, the following recommendations for improvement of farm mechanics instruction seem appropriate:

1. The community survey is desirable as a starting point in planning a farm mechanics course of study that will meet the needs of vocational agriculture students
2. A vitalized and well supervised farm mechanics home practice program should be a definite part of the course of study
3. Advanced, specialized agricultural mechanics courses should be made available to instructors who are in service
4. Farm shop training objectives of teacher training institutions are in need of revision
5. Research should be continued and extended in the areas of home farm facilities, relationship of farm shopwork and school shop activities, means of teacher selection and training at the college level and division of teaching materials for home practice programs as well as young farmer and adult farmer programs
6. More emphasis should be placed on the management and selection phases of farm mechanics activities

In 1951 Henslee[11] interviewed a large number of farmers in Oklahoma to determine which farm mechanics skills were most important to them. On the basis of the findings of his interview survey, the following conclusions were drawn regarding a program in farm mechanics:

1. Farm machinery maintenance and repair should be an important major part of the farm mechanics training course

2. Construction with wood, concrete, brick and tile should be included as worthwhile skills for students to acquire

3. The ability to perform certain electrical skills is very important in modern farming

4. Painting skills should be given more emphasis, especially in conjunction with farm machinery maintenance and repair

5. Farmers feel that, in order to become proficient as future farm operators, students should learn more detailed type skills than is even required of present farm operators

6. In order to provide needed training in farm mechanics for both present and prospective farmers, teachers of vocational agriculture need to give careful attention to the selection of equipment to teach many skills

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[11]Earl Dean Henslee, A Farm Mechanics Training Program In Vocational Agriculture, p. 31, Master's Degree Thesis, Oklahoma Agricultural and Mechanical College, Stillwater, 1951.

Sealover[12] and Finley[13] found that farmers lacked tools for performing many important adjustments and repairs needed on farm machinery, and concluded that establishment of home farm shops with necessary tools should receive a high degree of emphasis in the high-school farm-mechanics program. Like the Phipps-Deyoe study, the Sealover and Finley studies indicated the need for greater emphasis on preventive maintenance and adjustment of farm machinery.

Earlier studies by Geiger,[14] Sharp,[15] and Moore[16] also indicated that farm mechanics programs should emphasize farm

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[12]Elmer R. Sealover, "Needs as Related to Experience of Members of Farm Mechanics Classes for Young and Adult Farmers at the Mechanicsburg High School, Mechanicsburg, Pennsylvania," Summaries of Studies in Agricultural Education, p. 60, Vocational Educational Bulletin Number 253, Study Number 1820, Supplement Number 7, 1953.

[13]Charles Sager Finley, "Repair Jobs Performed on Farm Machinery and Shop Tools and Equipment Used by Arizona Farmers," Summaries of Studies in Agricultural Education, p. 19, Vocational Education Bulletin Number 253, Supplement Number 7, Study Number 1730, 1952.

[14]Albert James Geiger, "A Study of Farm Shop Work in Florida," Summaries of Studies in Agricultural Education, Vocational Education Bulletin Number 180, Study Number 119, 1935.

[15]Marlay Albert Sharp, "A Suggested Course of Study in Farm Mechanics for High Schools Based on the Opinions of Five Hundred Farmers," Summaries of Studies in Agricultural Education, Vocational Education Bulletin Number 180, Study Number 301, 1935.

[16]Tillman Marion Moore, "An Analysis of the Problem in Farm Shop Work as Related to Vocational Agriculture in Texas High Schools," Summaries of Studies in Agricultural Education, Vocational Education Bulletin Number 180, Supplement Number 1, Study Number 727, 1943.

repair work rather than construction. Geiger reported in 1932 that farmers devoted most of their time in farm shop to repair jobs, while teachers of agriculture devoted practically all of their teaching time to construction jobs. Twenty years later, Thompson[17] reported that teachers felt more time should be devoted to teaching jobs related to farm power and machinery.

In a study of farmers' needs for farm mechanics skills, Ryder[18] submitted a survey check list of 86 preventive maintenance skills to farmers, vocational agriculture teachers, members of agricultural education staffs, and members of an agricultural engineering staff. According to Ryder's findings, engineering experts considered more skills necessary to maintain productive mechanical efficiency on farms than did farmers themselves. The agricultural engineering staff rated more skills as essential than did any of the other groups. The next highest rating was given by the agricultural education staff, who rated more skills as essential than did the teachers. Farmers rated fewer skills as essential than did the other three groups.

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[17]Evans Guy Thompson, "Determining the Content of a Farm Power and Machinery Course for Vocational Agriculture High Schools in Virginia," Summaries of Studies in Agricultural Education, p. 67, Vocational Education Bulletin Number 253, Supplement Number 7, Study Number 1833, 1953.

[18]Ryder, loc. cit., p. 59.

A recent study by Chase[19] showed that 40 out of 50 agricultural teacher-trainers suggested modifying the vocational agriculture objectives to provide more emphasis on farm mechanics training. In Pennsylvania, according to a study by Anthony,[20] it was suggested that 144 of a total of 360 periods per year be devoted to "Farm Mechanics (Related to Supervised Farming Programs)".[21] The Pennsylvania Department of Public Instruction, then, recommended that about 40 per cent of the course time be devoted to farm mechanics.

Anthony[22] stated:

> In the final analysis the jobs in farm mechanization will be performed by future farmers on the farm and in the farm shop, and not in the school shop, where the present emphasis is now being placed. The establishment of a home farm shop should be given the highest priority in a well-balanced high school farm mechanics program.

Vocational agriculture teachers are in a good position to help future farmers by organizing the educational activities

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[19]Dan J. Chavez Chase, Objectives of Vocational Agriculture for Our Present Economy, Unpublished Report, Department of Agricultural Education, The Pennsylvania State University, State College, Pennsylvania, August, 1954, as quoted by Anthony, op. cit., p. 16.

[20]Frank Anthony, An Evaluation of the Current Objectives of the Farm Mechanics Phase of Vocational Agriculture in Selected Pennsylvania High Schools, p. 16, Ph.D. Dissertation, The Pennsylvania State University, The Graduate School, Department of Agricultural Education, June, 1956.

[21]Pennsylvania Department of Public Instruction, Vocational Agriculture in Pennsylvania, p. 1, Bulletin 250 (Revised) 1949, Harrisburg, as quoted by Anthony, ibid., p. 16.

[22]Anthony, op. cit., pp. 109-110.

to stimulate the establishment of a well-equipped home farm shop where machines can be repaired and serviced for longer life and greater efficiency at less cost.

Kinzie[23] developed six lesson plans designed for use by vocational agriculture teachers to help students develop shops on their home farms. He included a check list of tools and equipment for the home farm shop.

In studying other research in relation to farm mechanics, a continued emphasis on increased work in farm mechanics is noted. The more current research also emphasized repair and maintenance and less construction of large projects in the farm mechanics shop. Some of the curriculum studies indicated a definite lag in the teaching of farm mechanics abilities. However, the writer did not find any studies which suggested anticipating the farm mechanics abilities which farmers would need in the near future that were at present commonly referred to specialists. It is the opinion of the writer that the teaching of some abilities now considered to be specialties would encourage students to look toward the future. It would encourage the student to prepare for coming changes in agriculture as well as the possibilities of training in specialized

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[23]Robert Edwin Kinzie, "Establishing the Home Farm Shop", Summaries of Studies in Agricultural Education, p. 28, Vocational Education Bulletin Number 246, Supplement Number 4, Study Number 1257, 1949.

fields. For example, it appears that farm tractors will soon be equipped with automatic or semi-automatic transmissions similar to the "Select-O-Matic" now used on some modern tractors and that there will be a demand for specialists to improve and repair hydraulic transmissions and controls in the near future as well as a need for farmers to maintain, adjust and repair such units on their farm equipment.

SECTION V

FINDINGS

The data analyzed and interpreted in this section were compiled from questionnaires received from 129 farmers who received the South Dakota Farmer Degree in 1945 to 1955. Thirteen questionnaires were returned unopened because of incomplete or incorrect addresses. Completed questionnaires were received from 129 farmers and 92 persons in other occupations, all of whom had received the State Farmer Degree.

The returns from farmers were recorded and totaled. The Chi-square test of significance showed that the responses to four items were not significant at the two per cent level of confidence. Items included in this group were the abilities to weld with oxy-acetylene, repair a twine tie mechanism, clean and adjust fuel injectors, and understand basic principles of free piston engines. There was little agreement on the amount of oxy-acetylene welding done on farms of respondents or on the amount the respondents would use an understanding of the principles of free piston engines. The varied opinions regarding the importance of teaching the abilities to repair a twine tie mechanism and to clean and adjust fuel injectors reduced the level of confidence at which conclusions could be drawn from their responses. Responses which were significant at least

at the two per cent level of confidence were considered reliable enough to use in making comparisons and formulating conclusions.

One of the purposes of this research is to develop a list of abilities that should be taught in farm mechanics. Therefore, in arranging the data, the items in each area of farm mechanics were grouped according to the per cent of respondents who considered each item to be essential in the farm mechanics curriculum. The items within each area were then grouped in such a way that those considered essential by at least 50 per cent of the respondents were considered first. Those items which were considered essential by less than 50 per cent but more than 30 per cent of the respondents were considered next. Items which less than 30 per cent considered essential but more than 40 per cent considered either essential or very important were the last items which were considered of sufficient value to farmers at the present time to merit their inclusion in the recommended teaching content. The abilities related to the area of farm shopwork were considered first.

Farm Shopwork

In the area of farm shopwork, 50 per cent or more of the respondents considered eight items to be essential in the farm mechanics program. These items were the abilities to use tools safely, use power grinders, arc weld

in flat position, arc weld in horizontal position, arc weld lap joints, arc weld corner joints, and arc weld fillet joints. A mean of 62.7 per cent of the respondents had learned these abilities in high school, and a mean of 14.6 per cent had learned them after high school. In respect to their use on the farm a mean of 59.6 per cent had used these abilities or skills often, and 29.6 per cent had used them occasionally. A mean of 54.4 per cent considered them essential in the farm mechanics program. The responses to these items are shown in Table 1.

There were 18 items which more than 30 per cent but less than 50 per cent of the respondents considered to be essential in the farm mechanics program. These items were the abilities to use hand saws, use power saws, sharpen sickles, sharpen steel bits, thread bolts and nuts, install rivets, cut metal with an arc welder, cut metal with oxy-acetylene, bronze weld (braze) metals, arc weld in overhead position, hard face tools and equipment, arc weld butt joints, operate a drill press, identify common metals, select paint, clean and care for brushes, plan a home farm shop, and select shop equipment. It is interesting to note that a mean of only 16.6 per cent would seldom use the abilities. However, a mean of 13.1 per cent had not learned the abilities and a mean of 20 per cent had learned the abilities after high school. Table 2 points out that most of these abilities were learned either before or in high school.

Table 1. Percentages of Responses Concerning Farm Shopwork With Respect to Time of Development, Use and Importance of Abilities Which 50 Per Cent or More Considered Essential

Farm Shopwork Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Use tools safely	39.5	59.7	0	.8	91.5	6.2	.8	1.5	70.3	26.4	3.3	0
2. Arc weld in flat position	11.7	65.6	16.4	6.3	57.8	30.5	8.6	3.1	55.5	26.6	17.9	0
3. Arc weld in horizontal position	9.4	64.1	19.5	7.0	55.6	32.5	7.9	4.0	53.2	28.9	17.9	0
4. Arc weld fillet joints	7.1	66.7	15.1	11.1	51.2	34.1	10.6	4.1	52.9	22.3	22.3	2.5
5. Use power grinders	29.9	54.5	14.1	1.5	64.6	32.2	3.2	0	51.2	29.2	19.6	0
6. Arc weld corner joints	8.0	65.6	14.4	12.0	50.4	34.4	10.4	4.8	51.2	22.1	23.5	3.2
7. Arc weld in vertical position	8.6	60.1	21.9	9.4	51.6	36.5	6.3	5.6	50.9	29.6	19.5	0

Table 1. (continued)

Farm Shopwork Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
8. Arc weld lap joints	8.6	65.3	14.9	10.2	54.0	30.7	12.1	3.2	50.0	25.2	22.8	2.0
Mean	15.4	62.7	14.6	7.3	59.6	29.6	7.5	3.3	54.4	26.3	18.3	1.0

Table 2. Percentages of Responses Concerning Farm Shopwork With Respect to Time of Development, Use and Importance of Abilities Which More Than 30 Per Cent but Less Than 50 Per Cent Considered Essential

Farm Shopwork Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Arc weld butt joints	9.4	66.2	13.4	11.0	56.8	28.0	10.4	4.8	49.2	25.8	22.7	2.3
2. Use hand saws	68.1	31.2	.7	0	52.1	44.7	2.4	.8	44.6	21.0	32.8	1.6
3. Select shop equipment	10.4	48.8	36.0	4.8	34.4	45.1	19.7	.8	44.4	30.2	23.8	1.6
4. Cut metal with an arc welder	12.4	64.3	15.5	7.8	52.0	33.1	11.8	3.1	43.4	30.7	25.9	0
5. Cut metal with oxy-acetylene	1.6	40.9	19.7	37.8	36.9	28.7	18.0	16.4	43.2	27.2	27.2	2.4
6. Arc weld in over-head position	6.2	45.8	24.0	24.0	36.2	35.2	18.8	9.8	39.7	31.7	26.2	2.4
7. Identify common metals	9.3	59.7	20.2	10.8	44.5	33.3	19.8	2.4	39.4	26.8	29.1	4.7

Table 2. (continued)

Farm Shopwork Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
8. Operate a drill press	25.4	57.9	11.1	5.6	48.1	34.1	14.6	3.2	38.9	33.3	24.6	3.2
9. Thread bolts and nuts	44.2	29.4	21.8	4.6	48.8	39.9	8.7	4.0	38.3	25.8	30.5	5.4
10. Bronze weld (braze metals)	3.1	45.7	24.4	26.8	32.5	35.8	21.1	10.6	37.6	27.2	31.2	4.0
11. Sharpen sickles	41.9	17.2	31.9	9.0	47.2	45.0	3.9	3.9	37.4	32.5	28.5	1.6
12. Use power saws	6.3	67.6	19.0	7.1	27.2	52.8	15.2	4.8	36.3	25.1	36.2	2.4
13. Select paint	8.6	50.0	23.4	18.0	21.7	47.7	25.8	4.8	36.0	20.7	38.5	4.8
14. Install rivets	62.8	19.0	16.6	1.6	45.6	42.4	9.6	2.4	33.7	19.5	39.5	6.3
15. Plan a home or farm shop	6.3	53.1	28.1	12.5	17.2	36.1	39.3	7.4	32.8	29.6	33.6	4.0
16. Sharpen steel bits	5.4	59.8	20.9	13.9	34.4	36.0	23.2	6.4	32.6	20.6	39.7	7.1

Table 2. (continued)

Farm Shopwork Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
17. Clean and care for brushes	29.1	55.1	10.3	5.5	27.0	50.0	19.7	3.3	32.2	27.3	35.5	5.0
18. Hard face tools and equipment	2.4	38.1	23.8	35.7	21.6	39.2	19.2	20.0	30.2	26.2	34.1	9.5
Mean	19.6	47.3	20.0	13.1	38.0	39.4	16.6	6.0	38.7	26.7	31.2	3.8

There were six items on the questionnaire in farm shopwork which less than 30 per cent of the respondents considered essential but which more than 40 per cent considered either essential or very important. These items were considered to be of questionable value in the farm mechanics program and should be used only where the local situation or a local survey shows a definite demand for them. These six items were the abilities to sharpen knives, solder light metals, spray paint, prime new wood surfaces, apply interior paint, and apply exterior paint. Table 3 shows that a mean of 51.9 per cent of the respondents used these abilities occasionally. Only 20.9 per cent considered the abilities in Table 3 as being essential to the farm mechanics program.

When it was found that more than 60 per cent of the respondents considered an item to be neither essential nor very important in the farm mechanics program, it was decided those items should not be recommended for teaching content. In the area of farm shopwork, 20 items were included in this group. These items were the abilities to repair leather items, use a jack plane, dress grinding wheels, sharpen plane irons, sharpen hand saws, forge metals, make scale drawings, read blueprints, splice rope, tie a bowline knot, tie a half hitch, tie other knots and hitches, fit glass, apply glazier points and putty, make metal boxes and funnels, build a forge fire, temper and anneal tools,

Table 3. Percentage of Responses Concerning Farm Shopwork With Respect to Time of Development, Use and Importance of Abilities Which Less Than 30 Per Cent Considered Essential but Which 40 Per Cent or More Considered Either Essential or Very Important

Farm Shopwork Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Sharpen knives	40.7	43.0	13.2	3.1	33.4	46.8	19.8	0	26.4	19.2	50.4	4.0
2. Apply exterior paint	43.6	34.9	19.1	2.4	17.9	62.6	19.5	0	22.0	37.4	38.2	2.4
3. Spray paint	8.8	29.6	38.4	23.2	10.8	48.3	31.7	9.2	21.6	27.2	39.8	10.4
4. Solder light metals	14.7	66.7	9.3	9.3	15.6	43.8	37.5	3.1	20.6	24.6	50.0	4.8
5. Prime new wood surfaces	9.9	58.7	16.5	14.9	9.2	45.0	37.5	8.3	20.2	25.8	45.9	8.1
6. Apply interior paint	32.5	31.8	26.2	9.5	9.1	64.5	23.1	3.3	14.6	28.5	48.8	8.1
Mean	25.1	44.0	20.5	10.4	16.0	51.9	28.1	4.0	20.9	27.1	45.5	6.4

operate a metal lathe, mix paints from the basic ingredients, and prime new or rusty metals.

In reviewing the responses in the area of farm shopwork, one item was eliminated because the responses concerning the ability to weld with oxy-acetylene were not significant at the 2 per cent level of confidence, 20 items were considered not important because more than 60 per cent of the respondents had marked them as being neither essential nor very important in the farm mechanics program and should be taught only if required by local conditions. The writer considered the 26 abilities listed in Tables 1 and 2 to be essential in the teaching content. Six abilities listed in Table 3 were of lesser importance but more than 40 per cent of the respondents considered them to be either essential or very important. Therefore they are recommended for teaching if time permits.

Farm Power and Machinery

The data on farm shopwork showed that the majority of the persons considering an item to be essential or very important had learned that ability while in high school. However, in considering the items in farm power and machinery one finds a different picture. In farm power and machinery, the majority of the respondents considering these abilities to be either essential or very important had learned them after high school or had not yet learned them.

Nine abilities were considered essential by 50 per cent or more of the respondents. These were the abilities to adjust plows, determine cost, upkeep and depreciation of machinery, check machines for repair needs, adjust combines, adjust corn pickers, replace gears and bearings on field machines, clean and adjust spark plugs, clean and adjust carburetors, and recognize need for major repairs. Of these abilities the one item which had the highest per cent of respondents checking it essential was the ability to check machines for repair needs. This ability had been learned in high school by only 31 per cent of the respondents. A mean of 56 per cent checked these abilities as being essential in the farm mechanics program. About half the respondents used these abilities often and 37.5 per cent used these abilities frequently. About one fourth had learned these abilities in high school, whereas more than half had learned the abilities after high school. Table 4 shows all of the responses in this group.

Less than 50 per cent but more than 30 per cent of the respondents considered 11 abilities in the farm power and machinery area to be essential in the farm mechanics program. These were the abilities to repair a distributor or magneto, time an ignition system, adjust valve clearance, adjust friction clutches, adjust brakes, adjust and repack wheel bearings, calibrate sprayers, adjust cultivators,

Table 4. Percentages of Responses Concerning Farm Power and Machinery With Respect to Time of Development, Use and Importance of Abilities Which 50 Per Cent or More Considered Essential

Farm Power and Machinery Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Check machines for repair needs	34.9	31.0	33.3	.8	84.7	13.7	.8	.8	64.9	23.4	10.9	.8
2. Clean and adjust spark plugs	29.1	32.3	38.6	0	60.0	37.6	1.6	.8	59.4	22.7	14.8	3.1
3. Adjust plows	27.0	27.7	40.5	4.8	59.3	34.2	4.9	1.6	57.5	25.2	13.4	3.9
4. Adjust combines	9.5	9.5	76.2	4.8	57.3	34.7	4.0	4.0	57.0	25.0	15.7	2.3
5. Adjust corn pickers	8.7	8.6	74.8	7.9	55.2	32.8	5.6	6.4	55.5	26.6	16.6	2.3
6. Replace gears and bearings on field machines	19.2	15.2	61.6	4.0	53.2	40.3	5.7	.8	53.2	27.0	18.2	1.6
7. Recognize need for major repair	14.4	22.4	56.0	7.2	35.8	47.2	14.6	2.4	53.1	28.9	14.1	3.9

Table 4. (continued)

Farm Power and Machinery Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
8. Determine cost, upkeep and depreciation of machinery	.8	54.0	43.6	1.6	51.2	44.0	3.2	1.6	52.4	32.0	14.8	.8
9. Clean and adjust carburetors	6.4	33.3	48.4	11.9	33.1	53.2	11.3	2.4	51.2	25.6	21.6	1.6
Mean	16.7	26.0	52.5	4.8	54.4	37.5	5.8	2.3	56.0	26.3	15.5	2.2

replace ledger plates, straighten bent knife guards, and replace knife sections (sickle). Again, most of the respondents had learned these abilities after high school, and used them often or occasionally. It is interesting to note in Table 5 that the abilities most often checked as essential were those which had been learned at a rather low frequency in high school. All of the abilities in this group are of a preventive maintenance or repair and adjustment nature.

There were two abilities in farm power and machinery which less than 30 per cent considered essential but which more than 40 per cent considered to be either essential or very important. These were the abilities to remove and replace valves and to fit piston rings and bearings. A mean of 39.5 per cent of the respondents had never learned these abilities. As shown in Table 6, about one fourth of the respondents considered the abilities essential and nearly another fourth considered them very important.

More than 60 per cent of the respondents considered seven abilities in farm power and machinery to be neither essential nor very important. These were the abilities to convert horse drawn equipment to tractor hitches, adjust hydraulic clutches, grind valves, measure with a micrometer, understand basic principles of gas turbine engines, fuel cell engines, and planetary gear drives (automatic). More than half the respondents had not learned these abilities.

Table 5. Percentages of Responses Concerning Farm Power and Machinery With Respect to Time of Development, Use and Importance of Abilities Which More Than 30 Per Cent but Less Than 50 Per Cent Considered Essential

Farm Power and Machinery — Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Adjust cultivators	26.0	18.9	55.1	0	47.6	41.9	8.9	1.6	45.6	29.6	22.4	2.4
2. Adjust and repack wheel bearings	20.8	28.0	50.4	.8	32.8	53.3	13.9	0	43.2	29.6	25.6	1.6
3. Replace ledger plates	28.9	25.0	45.3	.8	39.7	51.2	7.4	1.7	41.3	31.0	26.9	.8
4. Time an ignition system	2.4	25.3	44.5	27.8	16.5	47.1	32.2	4.2	40.3	27.4	29.1	3.2
5. Replace knife sections (sickle)	39.1	27.3	32.8	.8	47.2	43.2	8.8	.8	40.2	29.1	29.9	.8
6. Adjust brakes	7.0	21.7	48.1	23.2	16.8	47.2	28.0	8.0	37.2	26.4	29.4	7.0
7. Repair distributor or magneto	4.9	23.8	33.6	37.7	16.4	51.6	21.1	10.9	37.8	24.4	30.7	7.1

Table 5. (continued)

Farm Power and Machinery Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
8. Adjust valve clearance	7.0	21.7	48.1	23.2	16.8	47.2	28.0	8.0	37.2	26.4	29.4	7.0
9. Calibrate sprayers	5.5	16.6	60.6	17.3	20.3	49.6	22.0	8.1	34.4	25.6	32.8	7.2
10. Straighten bent knife guards	20.5	22.8	47.2	9.5	33.1	43.2	16.9	6.8	33.9	22.1	33.0	11.8
11. Adjust friction clutches	39.1	27.3	32.8	.8	47.2	43.2	8.8	.8	40.2	29.1	29.9	.8
Mean	16.0	22.6	47.7	13.7	28.5	47.7	19.5	4.3	38.6	27.1	29.6	4.7

Table 6. Percentages of Responses Concerning Farm Power and Machinery With Respect to Time of Development, Use and Importance of Abilities Which Less Than 30 Per Cent Considered Essential but Which 40 Per Cent or More Considered Either Essential or Very Important

Farm Power and Machinery Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Fit rings and bearings	3.9	21.1	36.7	38.3	8.4	34.5	39.5	17.6	25.4	25.4	35.7	13.5
2. Remove and replace valves	4.0	20.0	35.2	40.8	8.3	34.7	38.0	19.0	23.8	22.2	36.5	17.5
Mean	4.0	20.6	35.9	39.5	8.4	34.6	38.7	18.3	24.6	23.8	36.1	15.5

With the exception of the ability to convert horse drawn equipment to tractor hitches, jobs requiring such abilities are those which are commonly referred to a specialist at the present time but may be performed by farmers 10 or 15 years hence. A mean of 16.8 per cent considered these abilities to be essential in the farm mechanics program, and a mean of 15.4 per cent considered them very important. These responses do not support the writer's hypothesis that these specialties would be considered important by farmers at the present time.

In reviewing the responses in the area of farm power and machinery one finds that the nine abilities listed in Table 4 were considered essential by a majority of the respondents. Eleven items listed in Table 5 were considered essential by more than 30 per cent but less than 50 per cent. Two items listed in Table 6 were of lesser importance but more than 40 per cent of the respondents had considered them to be either essential or very important. Seven abilities were considered not important because more than 60 per cent of the respondents had marked them as being neither essential nor very important. Three items were eliminated because the responses were not significant at the two per cent level of confidence. These items were the abilities to repair a twine tie mechanism, clean and adjust fuel injectors, and understand basic principles of free piston engines.

Farm Structures

In analyzing the responses to items related to buildings and other farm structures, an entirely different pattern was found. There were only two items which 50 per cent or more of the respondents considered to be essential in the farm mechanics program. They were the ability to mark and saw straight and square and the ability to construct and repair fences. A mean of 52.8 per cent of the respondents considered these abilities to be essential. Most of the respondents had learned the abilities either before or during high school and the abilities were used often by most of the respondents. Table 7 shows that 93.2 per cent of the respondents would use these abilities either often or occasionally.

Less than 50 per cent but more than 30 per cent of the respondents considered the abilities to figure bills of materials, plan good building arrangements, select and prepare concrete mixtures, select lumber, nails and bolts, repair windows and doors, and ventilate livestock housing as essential in the farm mechanics program. More than half the respondents had learned these abilities in high school and one third had learned them after high school. A mean of 20.1 per cent would use the abilities often and a mean of 53.1 per cent would use them occasionally. The two abilities shown in Table 7 and these six abilities shown

Table 7. Percentages of Responses Concerning Farm Structures With Respect to Time of Development, Use and Importance of Abilities Which 50 Per Cent or More Considered Essential

Farm Structures / Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Construct and repair fences	56.4	14.2	27.8	1.6	62.7	30.9	4.0	2.4	55.5	22.7	18.7	3.1
2. Mark and saw straight and square	24.6	68.0	4.0	1.6	54.4	38.4	7.2	0	50.0	35.7	11.1	3.2
Mean	41.4	41.1	15.9	1.6	58.6	34.6	5.6	1.2	52.8	29.2	14.9	3.1

in Table 8 are the abilities the respondents would consider to be essential in the farm mechanics program.

There were 17 abilities in the area of buildings and other farm structures which were considered to be essential by less than 30 per cent of the respondents, but 40 per cent or more considered the abilities either essential or very important. These were the abilities to lay out and level foundations, estimate quantities of brick, blocks, sand, and cement, finish and cure concrete, frame small buildings, lay out and cut rafters, lay roofing materials, select utilities and equipment, evaluate existing buildings, build portable feeders and equipment, build automatic feeding equipment, cut threads on and fit iron pipe, fit and install plastic pipe, repair leaky valves and faucets, maintain and repair pumps, build pole type buildings, and build open span buildings.

These abilities were learned in high school by a mean of only 31.9 per cent. However, a mean of 41.5 per cent had learned the abilities after high school and about one fourth of the respondents had not learned them. Table 9 shows that these abilities would not be used as often as the other abilities considered in farm structures, with a mean of only 7.9 per cent using the abilities often and a mean of 47.4 per cent using the abilities occasionally. They would be used seldom by a mean of 36.6 per cent and

Table 8. Percentages of Responses Concerning Farm Structures With Respect to Time of Development, Use and Importance of Abilities Which More Than 30 Per Cent but Less Than 50 Per Cent Considered Essential

Farm Structures / Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Select lumber, nails and bolts	11.1	55.5	30.2	3.2	36.9	53.3	7.4	2.4	49.2	26.6	23.4	.8
2. Figure bills of materials	4.8	73.8	15.1	6.3	28.2	55.7	12.9	3.2	41.6	29.6	24.8	4.0
3. Plan good building arrangement	.8	55.5	30.2	13.5	12.5	50.8	34.2	2.5	40.3	30.7	26.6	2.4
4. Repair windows and doors	14.4	44.0	39.2	2.4	20.3	58.6	20.3	.8	34.4	29.6	33.6	2.4
5. Ventilate livestock housing	1.6	30.9	46.4	21.1	12.1	40.3	35.5	12.1	32.8	30.4	29.6	7.2
6. Select and prepare concrete mixtures	5.5	52.3	36.7	5.5	10.5	59.7	24.2	5.6	30.7	34.7	32.2	2.4
Mean	6.4	52.0	33.0	8.6	20.1	53.1	22.4	4.4	38.2	30.3	28.3	3.2

Table 9. Percentages of Responses Concerning Farm Structures With Respect to Time of Development, Use and Importance of Abilities Which Less Than 30 Per Cent Considered Essential but Which 40 Per Cent or More Considered Either Essential or Very Important

Farm Structures / Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Select utilities and equipment	7.4	24.8	61.2	6.6	13.3	58.4	25.0	3.3	29.7	31.4	32.1	6.8
2. Lay out and level foundations	8.7	40.1	40.9	10.3	90.6	53.6	34.4	2.4	28.6	32.5	35.7	3.2
3. Finish and cure concrete	3.2	45.1	42.8	8.9	7.6	53.8	36.1	2.5	26.2	34.1	38.1	1.6
4. Lay roofing materials	15.4	37.4	43.1	4.1	8.2	61.5	27.0	3.3	24.0	36.0	36.0	4.0
5. Build portable feeders and so forth	2.4	75.2	18.4	4.0	9.7	53.2	33.9	3.2	22.8	27.6	44.9	4.7
6. Evaluate existing buildings	1.7	21.4	52.9	24.0	10.2	43.2	39.0	7.6	21.3	27.9	42.6	8.2

Table 9. (continued)

Farm Structures Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
7. Cut, thread and fit iron pipe	17.7	33.1	38.7	10.5	14.5	46.0	33.9	5.6	20.6	27.8	47.6	4.0
8. Frame small buildings	6.4	47.2	28.0	18.4	6.0	53.4	35.4	5.2	20.3	39.0	38.3	2.4
9. Lay out and cut rafters	4.0	58.7	19.0	18.3	3.3	51.6	36.1	9.0	20.0	34.8	40.0	5.2
10. Estimate quantities of brick, blocks, sand, cement, and so forth	1.6	50.8	29.0	18.6	8.9	45.2	41.9	4.0	20.0	33.6	40.8	5.6
11. Fit and install plastic pipe	.8	8.6	57.5	33.1	8.9	41.9	38.7	10.4	19.2	26.4	46.4	8.0
12. Repair leaky valves and faucets	7.9	18.1	60.6	13.4	10.4	52.0	33.6	4.0	18.4	27.2	48.0	6.4

Table 9. (continued)

Farm Structures Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
13. Maintain and repair pumps	4.7	16.5	64.6	8.9	8.9	51.2	34.2	5.7	17.5	29.4	45.2	7.9
14. Build open span buildings	1.6	16.8	32.0	49.6	5.0	31.1	41.2	22.7	16.5	24.0	48.8	10.7
15. Build pole type buildings	1.6	15.0	43.7	39.7	1.6	31.5	46.8	20.1	16.0	24.8	50.4	8.8
16. Lay tile, concrete blocks, and so forth	.8	12.9	40.3	46.0	1.7	40.9	46.1	11.3	14.4	27.2	47.2	11.2
17. Build automatic feeding equipment	0	21.2	33.3	45.5	5.7	37.4	39.8	17.1	13.0	28.5	43.1	15.4
Mean	5.1	31.9	41.5	21.5	7.9	47.4	36.6	8.1	20.5	30.1	42.7	6.7

never by a mean of 8.1 per cent.

More than 60 per cent of the respondents considered seven items to be neither essential nor very important in the farm mechanics program. They were the abilities to build septic tanks, repair and/or clean septic tanks, plan and lay new sewage tile, repair and maintain sewage tile, fit and solder copper pipe, install plumbing fixtures, and plan and install insulation. Since more than 60 per cent of the respondents considered these items to be neither essential nor very important, they were not recommended as items to be taught in the high school's vocational agriculture program. A mean of 38.6 per cent of the respondents had learned these abilities after high school and a mean of 46.5 per cent had not learned them. Half the respondents would seldom use the abilities if they possessed them and a fourth of the respondents would never use the abilities. With these responses the writer did not recommend that such abilities be taught in the school's farm mechanics program.

In the area of farm structures, two of the abilities included on the questionnaire were considered essential by more than half the respondents. Six items were considered essential by more than 30 per cent but less than 50 per cent of the respondents. There were 17 items which less than 30 per cent of the respondents indicated to be essential but which more than 40 per cent considered either essential or very important in the farm mechanics program. Seven items

were not recommended by the writer for the farm mechanics program because more than 60 per cent of the respondents had considered them as neither essential nor very important to the school's farm mechanics program in vocational agriculture. The responses to all 32 items in the area of farm structures were found to be significant at least at the one per cent level of confidence.

Farm Electrification

In farm electrification there was only one item which more than 50 per cent of the respondents considered to be essential in the farm mechanics program, namely, the ability to understand the basic principles of electrical safety. This item is included in Table 10 with those five items which less than 50 per cent but more than 30 per cent of the respondents considered to be essential. These items included the abilities to give first aid to victims of electric shock, replace fuses and/or circuit breakers, select wire sizes correctly, select electric motors, and understand basic principles of lightning protection. More than one fourth of the respondents had learned these abilities and understandings in high school. A mean of 40.6 per cent had learned them after high school and a mean of 20.5 per cent had not learned them. These abilities would be used often by about one fifth of the respondents, occasionally by a mean of 39.3 per cent, and seldom by one third of the respondents.

Table 10. Percentages of Responses Concerning Farm Electrification With Respect to Time of Development, Use and Importance of Abilities Which 30 Per Cent or More Considered Essential

Farm Electrification	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
Understand basic principles of:	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Electrical safety	7.3	53.2	31.5	8.0	50.0	31.6	13.1	5.3	65.6	19.3	11.7	3.4
2. Lightning protection	8.1	50.4	26.0	15.5	29.7	37.0	26.1	7.2	47.1	24.4	25.1	3.4
Ability to:												
3. Replace fuses and/or circuit breakers	34.4	23.2	40.0	2.4	31.4	52.1	15.7	.8	43.8	28.9	24.0	3.3
4. Give first aid to victims of electric shock	4.0	22.2	27.8	46.0	4.3	5.9	57.6	32.2	39.2	24.2	34.9	1.7
5. Select electric motors	2.4	24.8	69.6	3.2	12.0	60.8	27.2	0	32.5	37.5	28.3	1.7

Table 10. (continued)

Farm Electrification Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
6. Select wire sizes correctly	2.4	22.6	39.5	35.5	12.2	40.7	40.6	6.5	31.1	26.9	37.0	5.0
Mean of items 2-6	10.3	28.6	40.6	20.5	17.9	39.3	33.5	9.3	38.7	28.4	29.9	3.0

There were 12 items which less than 30 per cent of the respondents considered essential but more than 40 per cent considered either essential or very important in the farm mechanics program. These items include the abilities to select light fixtures and/or appliances, calculate electric loads, install lighting circuits, install outlet circuits, splice electric wires, repair electric cords, repair electric appliances, maintain and service motors, reverse rotation of motors, and install electric fence controls. This group also included an understanding of the basic principles of electric motor operation and heating with electricity. Of these items a mean of 21.8 per cent had learned them in high school, while 47.7 per cent had learned them after high school and one fourth of the respondents had not learned them. As shown in Table 11, the majority of the respondents would use these abilities and understandings often or occasionally if they possessed them.

More than 60 per cent of the respondents had considered nine items to be neither essential nor very important in the farm mechanics program. These items include the abilities to place yard distribution poles, install three-way and/or four-way switches, solder electric splices, repair electric motors, and change voltage of motors. They also include the basic understanding of electric generation and transmission, electric transformer operation, remote controls,

Table 11. Percentages of Responses Concerning Farm Electrification With Respect to Time of Development, Use and Importance of Abilities Which Less Than 30 Per Cent Considered Essential but Which 40 Per Cent or More Considered Either Essential or Very Important

Farm Electrification Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Calculate electric loads	0	20.3	43.1	36.6	7.4	41.3	38.0	13.3	29.2	27.5	39.1	4.2
2. Repair electric cords	15.2	33.6	45.6	5.6	20.7	55.4	22.3	1.6	27.7	37.0	33.6	1.7
3. Select light fixtures and/or appliances	2.4	16.1	70.2	11.3	12.4	52.9	33.9	.8	26.1	24.4	37.7	11.8
Understand basic principles of:												
4. Electric motor operation	3.3	46.3	29.3	21.1	10.1	38.5	40.4	11.0	25.6	26.5	40.2	7.7

Table 11. (continued)

Farm Electrification Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
5. Install outlet circuits	1.6	16.9	53.3	28.2	7.4	37.2	45.5	9.9	25.4	28.0	39.0	7.6
6. Maintain and service motors	3.2	28.8	51.2	16.8	18.3	50.0	28.3	3.4	24.6	33.1	40.6	1.7
7. Splice electric wires	8.8	26.4	46.4	18.4	9.1	46.3	36.4	8.2	23.5	26.9	41.2	8.4
8. Install lighting circuits	3.3	15.8	46.7	34.2	3.3	33.3	49.2	14.2	23.5	26.1	38.6	11.8
9. Install electric fence controls	18.6	12.9	53.2	15.3	20.2	41.2	34.4	4.2	22.0	24.6	41.5	11.9
10. Reverse rotation of motors	1.6	14.8	47.7	35.9	4.2	34.7	47.5	13.6	14.3	26.1	51.2	8.4
11. Repair electric appliances	1.6	12.8	43.2	42.4	12.4	41.3	35.5	10.8	13.7	32.5	35.9	17.9

Table 11. (continued)

Farm Electrification Understand basic principles of:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
12. Heating with electricity	1.6	17.1	42.3	39.0	9.2	38.5	36.7	15.6	12.3	29.0	44.7	14.0
Mean	5.1	21.8	47.7	25.4	11.2	42.6	37.3	8.9	22.3	28.5	40.3	8.9

and automatic timers. A mean of 18.1 per cent of the respondents had learned these abilities in high school, whereas, a mean of 30.3 per cent had learned them after high school and half the respondents had not learned them.

In the area of farm electrification, fewer respondents considered the abilities listed to be essential. Nine of the 27 items were considered to be neither essential nor very important by a mean of 70.6 per cent of the respondents. Only six items were considered essential by a mean of 30 per cent or more. All of the responses concerning abilities and understandings in farm electrification were significant at least at the one per cent level of confidence.

Soil and Water Management

An analysis of the responses concerning abilities in the soil and water management area indicated that the respondents did not feel this was an important area in the teaching of farm mechanics in high school. There were no abilities which 30 per cent or more of the respondents considered essential in the farm mechanics program. However, there were four items which less than 30 per cent considered essential but more than 40 per cent considered either essential or very important. These were the abilities to maintain drainage ditches, establish grass waterways, maintain grass waterways, and determine water needs. Although one fourth of the respondents had learned these abilities in high

school and a mean of 42.7 per cent had learned them after school, only a mean of 13.5 per cent felt that they would use these abilities often and a mean of 41.5 per cent would use them occasionally. One third of the respondents would seldom use the abilities and a mean of 12.2 per cent would never use them. Although more than half the respondents would use these abilities often or occasionally, Table 12 shows that only a mean of 21.1 per cent considered them essential in the farm mechanics program, and one fourth of the respondents considered these items to be very important. This indicates that more than half the respondents believed that jobs involving these abilities could better be done by someone other than the farmer.

More than 60 per cent of the respondents had indicated that the remaining 21 items in the area of soil and water management were neither essential nor very important in the teaching of farm mechanics. These responses, as shown by Table 13, indicate that two thirds of the respondents had not learned these abilities. A mean of 45.2 per cent would use the abilities only seldom, and a mean of 35.8 per cent would never use them.

Although one tenth of the respondents considered these abilities in soil and water management to be essential, there are some items which more respondents considered essential than most of the other items in this group. These are the abilities to lay out contour lines, which 16.9 per cent

Table 12. Percentages of Responses Concerning Soil and Water Management With Respect to Time of Development, Use and Importance of Abilities Which Less Than 30 Per Cent Considered Essential but Which 40 Per Cent or More Considered Either Essential or Very Important

Soil and Water Management Ability to:	When the ability was developed:				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Determine water needs	1.7	17.8	24.6	55.9	15.5	24.5	37.3	22.7	22.8	19.3	38.6	19.3
2. Maintain grass waterways	4.1	34.4	51.6	9.9	16.2	48.7	27.4	7.7	22.2	24.8	47.0	6.0
3. Establish grass waterways	4.9	38.2	48.0	8.9	13.6	51.7	28.8	5.9	22.1	28.7	43.5	5.7
4. Maintain drainage ditches	2.5	18.8	46.7	32.0	8.8	41.2	37.7	12.3	17.3	23.3	49.1	10.3
Mean	3.3	27.3	42.7	26.7	13.5	41.5	32.8	12.2	21.1	24.0	44.6	10.3

Table 13. Percentages of Responses Concerning Soil and Water Management With Respect to Time of Development, Use and Importance of Abilities Which 60 Per Cent or More Considered Neither Essential Nor Very Important

Soil and Water Management Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Lay out contour lines	0	29.3	14.7	56.0	3.5	23.0	46.9	26.6	16.9	21.2	43.3	18.6
2. Construct terraces	0	18.4	13.3	68.3	2.7	15.2	47.3	34.8	16.0	15.1	47.0	21.9
3. Plan pasture ponds and dugouts	1.7	17.3	40.5	40.5	5.3	32.5	45.6	16.6	15.6	21.8	47.8	14.8
4. Read contour maps	0	23.1	19.0	56.9	3.6	19.6	47.3	29.5	15.2	20.5	47.3	17.0
5. Plan and locate terraces	0	20.7	14.4	64.9	2.7	18.6	46.0	32.7	12.6	15.3	49.6	22.5
6. Build drainage ditches	2.5	19.8	41.3	36.4	7.8	34.8	41.7	15.7	12.3	20.8	50.9	16.0

Table 13. (continued)

Soil and Water Management Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
7. Maintain terraces	.8	16.7	16.7	65.8	1.8	21.4	46.4	30.4	12.1	21.6	49.1	17.2
8. Make land surveys	.8	22.3	18.2	58.7	5.4	17.8	51.8	25.0	11.7	20.8	45.0	22.5
9. Build pasture ponds and dugouts	.8	12.1	28.5	58.6	2.6	23.7	46.5	27.2	10.3	17.3	48.3	24.1
10. Maintain irrigation system	0	5.1	11.1	83.8	3.7	7.3	34.9	54.1	9.2	5.5	50.0	30.3
11. Plan dams and spillways	1.7	15.7	23.1	59.5	3.6	17.9	45.5	33.0	8.9	10.7	51.2	28.6
12. Make contour maps	0	22.5	10.8	66.7	3.6	13.4	46.4	36.6	8.9	19.6	47.4	24.1
13. Locate irrigation wells	0	3.3	6.8	89.9	2.7	4.5	35.1	57.7	7.3	7.3	50.5	34.9
14. Operate a transit level	2.5	13.3	22.5	61.7	2.7	9.7	56.6	31.0	7.2	9.0	48.7	35.1

Table 13. (continued)

Soil and Water Management Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
15. Determine per cent of slope	0	31.7	18.3	50.0	5.3	20.2	53.5	21.0	7.0	19.3	52.5	21.1
16. Develop sprinkler irrigation	0	5.1	12.7	82.2	2.7	10.7	32.1	54.5	7.0	7.1	53.4	32.5
17. Repair and/or maintain existing drainage tile	.9	10.8	10.8	77.5	0	11.7	41.4	46.9	6.3	10.8	50.5	32.4
18. Build dams and spillways	2.5	13.3	18.3	65.9	2.6	14.9	47.4	35.1	6.2	12.4	46.9	34.5
19. Level land for irrigation	0	11.6	9.2	79.2	.9	4.2	43.2	51.7	4.5	9.8	49.1	36.6
20. Lay new drainage tile	.8	12.5	8.3	78.4	0	8.2	41.8	50.0	3.6	11.6	46.4	38.4

Table 13. (continued)

Soil and Water Management Ability to:	When the ability was developed				Frequency with which the ability is used				Value of the ability in teaching programs			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
21. Operate a target rod	.8	10.8	15.7	72.7	.9	5.4	52.3	41.4	2.7	6.4	50.0	40.9
Mean	.7	15.8	18.2	65.3	3.1	15.9	45.2	35.8	9.6	14.5	48.8	27.0

of the respondents considered essential, read contour maps, plan and locate terraces, construct terraces, plan pasture ponds and dugouts, maintain terraces, and build drainage ditches.

In this research, there was little emphasis by the respondents on soil and water management abilities as compared with research done in states with more rainfall. This lack of emphasis on soil and water management may result from the tendency to overlook water erosion as a serious hazard on South Dakota farms. However, the writer had anticipated more emphasis on irrigation and water conservation practices such as contouring and terracing. Only one of the 129 farmers who returned completed questionnaires farmed any irrigated land.

SECTION VI

SUMMARY AND CONCLUSIONS

It was the purpose of this study to determine the present farm mechanics needs of farmers and upon such a basis to recommend changes in the farm mechanics phase of the curriculum in vocational agriculture for South Dakota high schools. An investigation was made of the farmers who had received the South Dakota Farmer Degree from 1945 through 1955 to determine the abilities which they use on their farms at the present time.

After reviewing appropriate literature, a comprehensive list of 170 abilities was selected to represent the farm mechanics abilities in past and present curricular offerings in farm mechanics as well as abilities involved in more technical jobs which are now commonly referred to specialists, but which may later be required of farmers. The list of abilities was subdivided into the five general areas of farm mechanics: farm shopwork, farm power and machinery, farm structures, farm electrification, and soil and water management. A questionnaire was devised which allowed the respondent to indicate when he had learned the ability, how frequently he used the ability or would use it if he could, and how important it was in the school's farm mechanics program. A copy of the questionnaire is included as Appendix E in this thesis.

Two hundred ninety five questionnaires were mailed to persons who had received the South Dakota Farmer Degree during the years 1945 through 1955. Of the 221 questionnaires returned, 92 were from persons in other occupations and 129 were from farmers.

The responses on questionnaires returned by the farmers were compiled and a chart was made showing the total number of persons checking each ability on the questionnaire. The number of responses was changed to the percentage of persons responding to each item in order that the responses could be compared with each other. The Chi-square test of statistical significance was applied to these responses and only those which were significant at the two per cent level of confidence were used in analyzing and interpreting the data.

A summary of these responses shows that the teaching emphasis had been in the areas of farm shopwork and farm structures during the years when these farmers were in high school. It was obvious from the responses of these farmers that they had received comprehensive training in the fields of farm shopwork and farm structures during their high school vocational agriculture studies. However, most of their abilities in farm power and machinery, rural electrification, and soil and water management were learned after high school or were yet unlearned.

The responses indicated that there is a need for increasing or adjusting the emphasis in farm mechanics. Increased emphasis is needed in farm power and machinery, especially in the abilities required for adjustment, maintenance and repair. In the area of farm electrification, increased emphasis is needed most in the areas of first aid, safety, replacement of fuses and circuit breakers, and in selection of proper equipment. There was little emphasis on the part of the respondents toward farm mechanics abilities related to soil and water management. The changing relative importance of the five areas of farm mechanics caused the farmers to rate the areas of farm power and machinery and farm electrification higher than their relative position of importance had been at the time the respondents were in high school.

If more emphasis in the farm mechanics program is to be put on the area of farm power and machinery or rural electrification, some changes will be necessary in the present program. Since it would be difficult to add more time to that which is now allotted for farm mechanics, something must be deleted from the present program. In organizing the revised teaching content in farm mechanics in South Dakota, the writer attempted to list abilities in the order in which they would be required by farmers at the present time. This would help the teacher of vocational agriculture

to select items to emphasize in each area of his farm mechanics program. The writer suggests that the items toward the top of the list receive the greater emphasis. Items toward the bottom of each list should be taught only if time is available or if they are demanded by a survey of the school service area. In some localities, irrigation or some other local condition may result in other abilities not on the recommended list being considered essential by the local vocational agriculture teacher.

The responses pointed out that the vocational agriculture teachers in South Dakota in 1945-1955 had done a thorough job of training these students in the abilities related to farm shopwork and farm structures. This is evidenced by the fact that the majority of the farmers responding indicated that they had developed these abilities in high school. However, the high school training in the areas of farm electrification and farm power and machinery had not met the needs of the graduates who were established in farming in 1960.

A few examples clearly illustrate the need for revision of teaching content. Some areas which seemed important at that time but which are no longer important to these farmers are rope work, planing and drawing. It was noted that means ranging from 64.2 to 75.3 per cent of the respondents learned these abilities while they were in high

school. As examples of the other extreme, the abilities to adjust combines and corn pickers were learned by 9.5 and 8.6 per cent of the respondents, respectively, while they were in high school. About three-fourths of them had learned these abilities after high school. They were used often by more than half the respondents, and about the same proportion considered them essential in the present farm mechanics program. Thus the data analyzed in this research indicate a continued need for revision in the farm mechanics program.

SECTION VII

RECOMMENDATIONS

The responses of 129 farmers who had received the South Dakota Farmer Degree indicated the need for revision of the teaching content in the high school vocational agriculture farm mechanics program. The greatest need indicated was for increased emphasis on the abilities needed for adjustment, maintenance and repair of farm machinery and repair and maintenance of buildings and other structures. A decreased emphasis in farm shopwork and building construction abilities was also clearly indicated.

In recommending the abilities which respondents considered most important, the writer listed them in the order in which the largest per cent of respondents indicated the ability to be essential. The abilities in each of the five areas of farm mechanics were listed separately.

The abilities in farm shopwork in the recommended order of importance are:

1. Use tools safely
2. Arc weld in flat position
3. Arc weld in horizontal position
4. Arc weld fillet joints
5. Use power grinders
6. Arc weld corner joints
7. Arc weld in vertical position
8. Arc weld lap joints
9. Arc weld butt joints
10. Use hand saws
11. Select shop equipment
12. Cut metal with an arc welder
13. Cut metal with oxy-acetylene

14. Arc weld in overhead position
15. Identify common metals
16. Operate a drill press
17. Thread bolts and nuts
18. Bronze weld (braze metals)
19. Sharpen sickles
20. Use power saws
21. Select paint
22. Install rivets
23. Plan a home or farm shop
24. Sharpen steel bits
25. Clean and care for brushes
26. Hard face tools and equipment
27. Sharpen knives
28. Apply exterior paint
29. Spray paint
30. Solder light metals
31. Prime new wood surfaces
32. Apply interior paint

Sixty per cent or more considered 20 abilities, which were included on the questionnaire, to be neither essential nor very important. Therefore, they were not included on the recommended list.

The recommended order of importance of abilities in the area of farm power and machinery is:

1. Check machines for repair needs
2. Clean and adjust spark plugs
3. Adjust plows
4. Adjust combines
5. Adjust corn pickers
6. Replace gears and bearings on field machines
7. Recognize need for major repair
8. Determine cost, upkeep and depreciation of machinery
9. Clean and adjust carburetors
10. Adjust cultivators
11. Adjust and repack wheel bearings
12. Replace ledger plates
13. Time an ignition system
14. Replace knife sections (sickle)
15. Adjust brakes
16. Repair distributor or magneto
17. Adjust valve clearance

18. Calibrate sprayers
19. Straighten bent knife guards
20. Adjust friction clutches
21. Fit rings and bearings
22. Remove and replace valves

Seven abilities were not recommended because less than 40 per cent of the respondents considered them to be either essential or very important.

The recommended order of importance of abilities in the area of farm structures is:

1. Construct and repair fences
2. Mark and saw straight and square
3. Select lumber, nails and bolts
4. Figure bills of materials
5. Plan good building arrangement
6. Repair windows and doors
7. Ventilate livestock housing
8. Select and prepare concrete mixtures
9. Select utilities and equipment
10. Lay out and level foundations
11. Finish and cure concrete
12. Lay roofing materials
13. Build portable feeders and so forth
14. Evaluate existing buildings
15. Cut, thread and fit iron pipe
16. Frame small buildings
17. Lay out and cut rafters
18. Estimate quantities of brick, blocks, sand, cement, and so forth
19. Fit and install plastic pipe
20. Repair leaky valves and faucets
21. Maintain and repair pumps
22. Build open span buildings
23. Build pole type buildings
24. Lay tile, concrete blocks, and so forth
25. Build automatic feeding equipment

Seven abilities were not recommended because less than 40 per cent of the respondents considered them to be either essential or very important.

The recommended order of importance of the selected abilities in the area of farm electrification is:

1. Understand electrical safety
2. Understand lightning protection
3. Replace fuses and/or circuit breakers
4. Give first aid to victims of shock
5. Select electric motors
6. Select wire sizes correctly
7. Calculate electric loads
8. Repair electric cords
9. Select light fixtures and/or appliances
10. Understand electric motor operation
11. Install outlet circuits
12. Maintain and service motors
13. Splice electric wires
14. Install lighting circuits
15. Install electric fence controls
16. Reverse rotation of motors
17. Repair electric appliances
18. Understand heating with electricity

Nine abilities were not recommended because less than 40 per cent of the respondents considered them to be either essential or very important.

The recommended order of importance of abilities in the area of soil and water management is:

1. Determine water needs
2. Maintain grass waterways
3. Establish grass waterways
4. Maintain drainage ditches

In the area of soil and water management, 21 abilities were not recommended because less than 40 per cent had considered them either essential or very important.

Broader changes are implied as a result of recommending revised teaching programs for use by high school vocational agriculture teachers. It is difficult for a teacher to include farm mechanics abilities in a teaching plan unless

he has had training or experience enabling him to become proficient in the abilities concerned. Therefore it is also recommended that further research be conducted to more accurately determine which new abilities will be required in future years so these abilities can be included in the pre-service training of prospective teachers. Agricultural engineering experts, machinery design engineers and teacher education staff members throughout the nation are qualified to help determine future farm mechanics needs.

Since teachers likely emphasize those farm mechanics abilities for which they are best trained, the writer also recommends continued improvement and expansion of the pre-service and in-service teacher training programs in modern mechanized agriculture. Farm shop practices should emphasize abilities needed in repair and maintenance of farm structures and equipment. Welding should continue to be an important part of the pre-service training. Soil and water conservation instruction should deal primarily with management decisions involved in properly maintaining productivity through the existing services available to farmers and farming methods which further soil and water conservation. The course in farm power and machinery should be replaced by two separate courses, one in farm tractor maintenance and overhaul and another in farm machinery maintenance and overhaul. These two courses should also be taught in alternate summers on a graduate level. In-service workshops during

the summer months have been a valuable addition to the training in mechanized agriculture. These workshops should be continued and expanded to include machine adjustment and repair, and the management abilities needed to maintain the efficiency of farm machinery. Such revisions should be based on careful study of the programs of other states in order to profit from their experiences and research.

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APPENDIX A

Lake Preston, South Dakota
June 29, 1959

Mr. Harold Urton, State Supervisor
Vocational Agriculture
Department of Public Instruction
Pierre, South Dakota

Dear Mr. Urton:

In developing a thesis, as part of the work toward a M. S. Degree at South Dakota State College, entitled "What Technical Abilities and Manipulative Skills Should be Taught in a High School Vocational Agriculture Farm Mechanics Program in South Dakota", I have decided to send questionnaires to a random sample of the graduates who received the degree of South Dakota Farmer in the years 1945 to 1955 inclusive.

Will you please send me a list of the State Farmers from those years and the school from which each graduated?

Although I have only started to work on this, it appears to be a very interesting problem. I hope to have it completed by the end of the summer of 1960.

Thank you for your help.

Sincerely,

Charles O. Stormo
Vocational Agriculture
Instructor
Lake Preston, South Dakota

APPENDIX B

Lake Preston, South Dakota
April 2, 1960

Mr. John Doe
Vocational Agriculture Instructor

Dear Mr. Doe:

I am doing some research to determine which technical abilities and shop skills are important to the Vocational Agriculture graduate at the present time. I plan to send questionnaires to the men who represented your school as South Dakota State Farmers in the years 1945 to 1955 inclusive.

Please put the person's present address, or last known address, after his name and return the list to me immediately. I am enclosing two lists of the degree recipients from your school in 1945-1955 so that you can keep one in your file if you wish.

Thank you for your cooperation.

Sincerely,

Charles O. Stormo
Vocational Agriculture
Instructor
Lake Preston, South Dakota

Enclosures 2

APPENDIX C

ALCESTOR

The following graduates from the Alcester High School received the South Dakota Farmer Degree in the year indicated. Please list the most recent address you have for each.

Name	Year	Address
Dale Paulson	1945	
Robert Schumacher	1950	
Arnold Sweegen	1950	
Roger Johnson	1950	
Shernold Anderson	1950	
Roger Anderson	1951	
Merton Turner	1952	
V. Dean Johnson	1952	
Dale Hagen	1952	
Richard D. Lundgren	1953	
Roger Herbrandson	1953	
Orlin E. Anderson	1954	
James Leafstedt	1954	
Donald Ray Abraham	1954	
Robert Abraham	1955	
Clark F. Anderron	1955	
Duane Ludwig	1955	
Donald R. Wiberg	1955	

APPENDIX D

Lake Preston, South Dakota
June 9, 1960

Mr. John Doe

Dear Sir:

I am doing some research to determine what technical abilities and shop skills should be taught in Vocational Agriculture farm mechanics classes. I am sending a questionnaire to you because, when you were in high school, you were selected for the degree of South Dakota Farmer. Since you possess the qualities necessary for such recognition, you can be of assistance in this attempt to keep our farm mechanics instruction up to date and as effective as possible.

Please answer the enclosed questionnaire as completely and accurately as possible and return it to me in the enclosed stamped self addressed envelope. Feel free to add any other abilities you like on the extra lines. All answers will be treated confidentially.

Since time is an important factor in this research, I would like to ask that you complete the enclosed questionnaire promptly.

Thank you kindly for your cooperation.

Sincerely,

Charles O. Stormo
Vocational Agriculture
Instructor
Lake Preston, South Dakota

Enclosures 2

APPENDIX E

SHOP SKILLS ABILITY AND UNDERSTANDING QUESTIONNAIRE

YOUR NAME _____
ADDRESS _____
In what year did you graduate from high school? _____
After entering high school, how many years have you lived on a farm? _____
What is your present occupation? (Check the one which most nearly applies.)
_____ Farming. _____ Machine operator or mechanic. _____ Construction worker.
_____ Carpenter or mason. _____ Other. (Specify) _____

DIRECTIONS: Please check (✓) the most appropriate space in each series of answers. (See the example below.)

NOTE: In this questionnaire the word "ability" means technical ability or shop skill.

	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
A. FARM SHOPWORK Ability to:	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Lace a belt (example)		✓					✓					✓
2. Repair leather items												

A. Farm Shopwork Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
3. Use tools safely												
4. Use a jack plane												
5. Use hand saws												
6. Use power saws												
7. Use power grinders												
8. Dress grinding wheels												
9. Sharpen sickles												
10. Sharpen plane irons												
11. Sharpen steel bits												
12. Sharpen knives												
13. Sharpen hand saws												

A. Farm Shopwork Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
14. Thread bolts and nuts												
15. Install rivets												
16. Solder light metals												
17. Forge metals												
18. Make scale drawings												
19. Read blueprints												
20. Splice rope												
21. Tie a bowline knot												
22. Tie a half hitch												
23. Tie other knots and hitches												
24. Fit glass												
25. Apply glazier points and putty												

A. Farm Shopwork Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
26. Make metal boxes, funnels, etc.												
27. Build a forge fire												
28. Temper and anneal tools												
29. Cut metal with an arc welder												
30. Cut metal with oxy-acetylene												
31. Bronze weld (braze) metals												
32. Arc weld in flat position												
33. Arc weld in horizontal position												
34. Arc weld in vertical position												
35. Arc weld in overhead position												
36. Hard face tools and equipment												
37. Arc weld butt joints												

A. Farm Shopwork Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
38. Arc weld lap joints												
39. Arc weld corner joints												
40. Arc weld fillet joints												
41. Weld with oxy-acetylene												
42. Operate a drill press												
43. Operate a metal lathe												
44. Identify common metals												
45. Select paint												
46. Mix paints from the basic ingredients												
47. Clean and care for brushes												
48. Spray paint												
49. Prime new wood surfaces												

	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
A. Farm Shopwork Ability to:	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
50. Prime new or rusty metals												
51. Apply interior paint												
52. Apply exterior paint												
53. Plan a home or farm shop												
54. Select shop equipment												
B. Farm Power and Machinery												
1. Adjust plows properly												
2. Convert horse drawn equipment to tractor hitches												
3. Determine cost, upkeep and depreciation of machinery												

B. Farm Power and Machinery Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
4. Check machines for repair needs												
5. Adjust combines properly												
6. Adjust corn pickers properly												
7. Repair a twine tie mechanism												
8. Replace gears and bearings on field machines												
9. Clean and adjust spark plugs												
10. Clean and adjust fuel injectors												
11. Clean and adjust carburetors												
12. Repair distributor or magneto												
13. Time an ignition system												
14. Adjust valve clearance												

B. Farm Power and Machinery Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
15. Adjust friction clutches												
16. Adjust hydraulic clutches												
17. Adjust brakes												
18. Adjust and repack wheel bearings												
19. Grind valves												
20. Remove and replace valves												
21. Fit rings and bearings												
22. Measure with a micrometer												
23. Recognize need for major repair												
24. Calibrate sprayers												
25. Adjust cultivators properly												
26. Replace ledger plates in guards												

	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
B. Farm Power and Machinery Ability to:	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
27. Straighten bent knife guards												
28. Replace knife sections (sickle)												
Understand basic principles of:												
29. Gas turbine engines												
30. Free piston engines												
31. Fuel cell engines												
32. Planetary gear drives (automatic)												
C. Buildings and Other Structures												
1. Figure bills of materials												

C. Buildings and Other Structures Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
2. Mark and saw straight and square												
3. Lay out and level foundations												
4. Estimate quantities of brick, blocks, sand, cement, etc.												
5. Plan good building arrangement												
6. Select and prepare concrete mixtures												
7. Finish and cure concrete												
8. Lay tile, concrete blocks, etc.												
9. Frame small buildings												
10. Lay out and cut rafters												
11. Lay roofing materials												
12. Select utilities and equipment												

C. Buildings and Other Structures Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
13. Evaluate existing buildings												
14. Select lumber, nails and bolts												
15. Repair windows and doors												
16. Build portable feeders, etc.												
17. Build automatic feeding equipment												
18. Build septic tanks												
19. Repair and/or clean septic tanks												
20. Plan and lay new sewage tile												
21. Repair and maintain sewage tile												
22. Cut, thread and fit iron pipe												
23. Fit and solder copper pipe												

Buildings and Other Structures Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
24. Fit and install plastic pipe												
25. Repair leaky valves and faucets												
26. Maintain and repair pumps												
27. Install plumbing fixtures												
28. Build pole type buildings												
29. Build open span buildings												
30. Construct and repair fences												
31. Plan and install insulation												
32. Ventilate livestock housing												

D. Farm Electrification Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Give first aid to victims of electric shock												
2. Replace fuses and/or circuit breakers												
3. Place yard distribution poles												
4. Select wire sizes correctly												
5. Select light fixtures and/or appliances												
6. Select electric motors												
7. Calculate electric loads												
8. Install lighting circuits												
9. Install outlet circuits												
10. Install 3-way and/or 4-way switches												
11. Splice electric wires												

D. Farm Electrification Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
12. Solder electric splices												
13. Repair electric cords												
14. Repair electric appliances												
15. Maintain and service motors												
16. Repair electric motors												
17. Reverse rotation of motors												
18. Change voltage of motors												
19. Install electric fence controls												
Understand basic principles of:												
20. Electric generation and transmission												

D. Farm Electrification Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
Understand basic principles of:												
21. Electric transformer operation												
22. Electric motor operation												
23. Remote controls												
24. Automatic timers												
25. Heating with electricity												
26. Electrical safety												
27. Lightning protection												

E. Soil and Water Management Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
1. Operate a transit level												
2. Operate a target rod												
3. Determine per cent of slope												
4. Lay out contour lines												
5. Make contour maps												
6. Read contour maps												
7. Make land surveys												
8. Plan and locate terraces												
9. Construct terraces												
10. Maintain terraces												
11. Level land for irrigation												

E. Soil and Water Management Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
12. Lay new drainage tile												
13. Repair and/or maintain existing drainage tile												
14. Plan dams and spillways												
15. Build dams and spillways												
16. Plan pasture ponds and dugouts												
17. Build pasture ponds and dugouts												
18. Build drainage ditches												
19. Maintain drainage ditches												
20. Establish grass waterways												
21. Maintain grass waterways												
22. Develop sprinkler irrigation												
23. Maintain irrigation system												

E. Soil and Water Management Ability to:	When did you learn the ability or shop skill?				How frequently do you use the ability or skill - or would if you could?				How valuable is its inclusion in the school's farm mechanics program?			
	Before high school	In high school	After high school	Have not learned it	Often	Occasionally	Seldom	Never	Essential	Very important	Important	Not important
24. Locate irrigation wells												
25. Determine water needs												

Question - Do you farm any irrigated land? _____yes. _____no.

Remarks:

APPENDIX F

Lake Preston, South Dakota
July 5, 1960

Mr. John Doe

Dear Sir:

On June 10th I sent you a questionnaire which you have not returned, or which has been lost in the mails. The return of a questionnaire from you is very important to this study.

I know that you are busy and (or) may have mislaid the first copy you received so I am sending you another questionnaire and stamped self addressed envelope. If you do not have time to complete the entire questionnaire (15-20 minutes), please fill in the information requested at the top of page one (1-3 minutes) and mail it to me.

If you have sent me a questionnaire within the last few days, please disregard this letter.

Thank you for your time and cooperation.

Sincerely,

Charles O. Stormo
Vocational Agriculture
Instructor
Lake Preston, South Dakota

Enclosures 2