THE DEVELOPMENT OF BASIC AGRICULTURAL MECHANICS SKILLS BY BUILDING A SMALL PROJECT

by 680

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CHAPTER I

INTRODUCTION

This report and study was based on an observation by the writer that in the field of agricultural education as well as the other fields of education, there had been considerable work on teaching methods. It was assumed that one of the areas of agricultural education which had had consideration had been agricultural mechanics. It was felt that this consideration had come about due to an observation of the great expansion of farm mechanization and the steadily rising costs of farm machinery and equipment. Dr. Lloyd J. Phipps stated that "with the increasing mechanization of work, a person employed in agriculture cannot be a success unless he posses considerable mechanical knowledge and skill."[1]

The study resulted from a belief on the part of the writer that the unit of agricultural mechanics which had received the greatest amount of concern had been farm machinery repair and maintenance, but a unit equally important, basic mechanics skills, had not changed to a great extent during the past years. This unit had been the basis

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[1] Lloyd J. Phipps, Mechanics in Agriculture (Danville: The Interstate Printers and Publishers, Inc., 1967), p. 4.

of all mechanics repair jobs and in the opinion of the writer should have been revised and updated to meet the needs of Agriculture at the time of the study.

The writer had been employed by the Washington Schools from July 1966, to the time of the study. Washington was a small community in North Central Kansas. The Vocational Agriculture One enrollment had been about ten boys yearly at the time of the study.

It had been observed by the writer that among some of the vocational agriculture instructors in Kansas, there had been a feeling that small projects could be used as a method of teaching the basic agricultural mechanics skills. Other instructors had felt that a drill method was the most efficient method for teaching the same basic skills.

I. STATEMENT OF THE PROBLEM

The purpose of this study was to compare the small project and the drill method of instruction. The statement of the problem then became the question of which method (small project method or drill method)[2] of teaching the basic agricultural mechanics skills in arc welding and farm carpentry was best suited for the 1967-68 Vocational Agriculture One class in the Washington High School, Washington,

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[2]See definitions on page 4.

Kansas, when applied to boys who were grouped for agricultural mechanics instruction.

II. OBJECTIVE

The objective of the study was to compare the results of the small project method of teaching agricultural mechanics with the drill method of teaching agricultural mechanics as measured by the ability of Vocational Agriculture One students to become proficient in performing selected basic agricultural mechanics skills.

III. ASSUMPTIONS

In instrumenting this study the writer made several assumptions as follows:

1. Small groups were an effective method of handling Agricultural Mechanics One students;
2. Arc Welding and Carpentry were basic elements of an Agricultural Mechanics One course;
3. The selection of a small project by the student indicated an interest in skill development;
4. Upon completion of the project the students would have a feeling of accomplishment;
5. The project would serve as a stimulant for skill development; and,
6. Visual testing and the judgment of the graders was

an appropriate method of measuring each group.

IV. HYPOTHESIS

The hypothesis for the study was that the students who had the small project method of instruction would exceed the accomplishments of the students using the drill method of instruction in the performance of basic arc welding and basic farm carpentry skills.

V. LIMITATIONS

Limitations of the study were:

1. The groups were limited to four subjects each;
2. The equipment used in the study was limited to that which was available in the local school;
3. The pre-test and post-test used were limited to those developed by the writer; and,
4. The evaluation of skill development was limited to the visual testing of evaluators who were staff members of the Washington High School.

VI. DEFINITION OF TERMS

The following definitions were used in planning, conducting and evaluating the study and were not necessarily those definitions or common usage at the time of the study.

Small project method. Small project method was a term used for the development of basic arc welding and farm carpentry skills by the construction of a small project.

Drill method. Drill method was a term used for the development by continuous practice or repetition of basic arc welding and farm carpentry skills.

Small project. A small project was a project that could be constructed in a short time as well as being economical (less than $5.00).

Visual testing. The evaluation of mechanical work formed by the subjective observations of the work by a grader.

CHAPTER II

REVIEW OF SELECTED LITERATURE

The writer in his search for literature related to the study reviewed literature from the Kansas State University Library, the Washington High School library, the Washington Vocational Agriculture library, and his personal library.

The writer found very little reading material which he felt was directly related to the study. There were no reports of studies found on the use of small projects as a method of teaching agricultural mechanics skills. Although there was found like studies relating to experimental work done with the basic theories of learning, no work was found to involve the comparison of the small project and drill method of teaching basic arc welding and farm carpentry skills.

It has been stated in psychology ". . . the child must do his own learning. . . . Thus all education is self-education."[1] In order for the child to learn there must be a stimulating factor which will encourage him to ". . . want something, notice something, do something and get

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[1]George J. Mouly, Psychology for Effective Teaching (New York: Holt, Rinehart and Winston, 1960), p. 13.

something."[2]

The National Future Farmers of America Organization for boys studying Vocational Agriculture in the public Secondary school adopted and upheld a motto containing the line . . . "Doing to Learn . . ."[3] which showed the thinking of the youth themselves as well as the educators of the time of adoption.

Lloyd J. Phipps, Professor in Agriculture Education, University of Illinois, recommended that a student should obtain experience in agriculture mechanics skills by starting with a project which has practical value but which was not too difficult.[4] Dr. Phipps further emphasized that "with the increasing mechanization of work, a person employed in agriculture cannot be a success unless he possesses considerable mechanical knowledge and skill."[5]

Although the psychology of learning literature appeared to the writer to favor a small project method of instruction, the amount of reference to this method was found to be meager. However, there was not much literature

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[2] Ibid., p. 220.

[3] _______, Official Manual Future Farmers of America (Alexandria: Future Farmers Supply Service, 1967), p. 13.

[4] Lloyd J. Phipps, Mechanics in Agriculture (Danville: The Interstate Printers and Publishers, Inc., 1967), p. 13.

[5] Ibid., p. 4.

found relating to the drill method.

In reviewing the text-books which were available for Agricultural Mechanics One courses there appeared to the writer to be merit in both methods, because both the drill procedure and the small project method were included.

In Mechanics in Agriculture by Phipps, emphasis had been placed on the technique of performing skills with reference to projects which require the skills in their construction. For example in arc welding the skills were selecting welding equipment, selecting electrodes, setting amperage, striking and holding an arc running a bead and constructing different joints. The projects which required the skills were a welding seat and a barrel stand.[6]

In carpentry some of the skills a student should develop were selecting and using measuring tools, selecting and using hand saws, selecting and using fastening devices, and selecting and applying finishes. The project which required the skills were a nail box, a sawhorse, a file rack and miter box.[7]

In Farm Mechanics Text and Handbook by Phipps, McCally, Scranton, and Cook the same arc welding skills and projects

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[6]Lloyd J. Phipps, Mechanics in Agriculture (Danville: The Interstate Printers and Publishers, Inc., 1967), pp. 226, 228, 231, 232, 234, and 239.

[7]Ibid., pp. 64, 70, 173, and 194.

were emphasized. However, there was a complete chapter devoted to farm carpentry projects. The small projects listed in the chapter were a bench nook, egg candler and sawhorse.[8]

Farm Shop Skills in Mechanized Agriculture by Sampson, Mowery and Kugler was found to be a book which dealt with the correct technique of performing shop skills. The skills covered in arc welding were the selection of welding electrodes, the types of welding joints, striking the arc, setting amperage and running a bead.[9] The skills covered in farm carpentry were measuring and marking wood, using handsaws, methods of wood planing, selecting and using wood chisels, boring holes in wood and fastening lumber.[10] In addition to the skill development the authors have included a chapter on farm shop projects. Among the projects included were several small arc welding and carpentry projects as follows:

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[8]Lloyd J. Phipps and others, Farm Mechanics Text and Handbook (Danville: The Interstate Printers and Publishers, Inc., 1959), pp. 193, 195, 196, and 197.

[9]Harry D. Sampson, Albert S. Mowery and Harold L. Kugler, Farm Shop Skills in Mechanized Agriculture (Chicago: American Technical Society, 1955), pp. 229, 233, 234, 235, and 238.

[10]Harry D. Sampson, Albert S. Mowery and Harold L. Kugler, Farm Shop Skills in Mechanized Agriculture (Chicago: American Technical Society, 1955), pp. 20, 22, 26, 32, 33, 35, and 40.

1. Welding jigs for holding elevator and conveyor flights,
2. Trailer hitch,
3. Saw vices,
4. Push stick,
5. Nail box,
6. Small tool box, and
7. Sawhorse.[11]

In _Shopwork on the Farm_ by Jones very little emphasis was found to be placed on small arc welding projects but a great deal was written on the technique of performing arc welding skills. While the technique of performing farm carpentry skills was emphasized there was also emphasis placed on small carpentry projects such as:

1. Tool box,
2. Nail box,
3. Miter box,
4. Bench hook,
5. Sawhorse,
6. Flower box,
7. Wood float, and
8. Saw filing clamp.[12]

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[11] _Ibid._, p. 356.

[12] Mack M. Jones, _Shopwork on the Farm_ (New York: McGraw-Hill Book Company, Inc., 1955), p. 135.

Arc Welding Lessons For School and Farm Shop by Harold L. Kugler was found to be completely devoted to arc welding technology and skills. The book consisted of three parts. The first being informational lessons. The second was operations to develop skill in using arc welding equipment and part three was devoted to arc welding projects. Some of the projects were shoescrapers, metal sawhorses, steel post driver, clothesline posts, gates and many more.[13]

Another book found to be completely devoted to arc welding was Farm Arc Welding by Morford. This book consisted of three parts. The first being on welding information, the second on repair, alteration and construction of farm equipment and the third on useful information. Here again emphasis was placed on the technique with reference to project construction.[14]

Although not much literature was found directly related to the use of the small project method or the drill method of teaching agricultural mechanics skills, there was enough evidence for both methods so that the writer felt it appropriate to compare the two methods in the Washington Agricultural Mechanics One course.

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[13]Harold L. Kugler, Arc Welding Lessons for School and Farm Shop (Cleveland: The Jones F. Lincoln Arc Welding Foundation, 1950), pp. 310, 311, 312 and 313.

[14]V. J. Morford, Farm Arc Welding (Cleveland: The Jones F. Lincoln Arc Welding Foundation, 1966).

CHAPTER III

DESIGN AND PROCEDURE

I. THE GROUPS

The study was conducted during the second semester of 1967-68 school year in the Vocational Agriculture One class of eight boys. In order to compare the equality of the two groups of four boys each, three criterion factors were used as follows:

1. The Intelligence Quotient Scores of each individual obtained from the Slossen Intelligence Test for Children and Adults.
2. The students' grade point average at the end of the first semester 1967-68 school year.
3. The students' scores on the written pre-test covering arc welding and farm carpentry.

This class was divided into two groups. The class members were asked to select which project they would like to construct, an arc welding project or a carpentry project. This selection placed them into one of two groups. One group being the group which constructed an arc welding project, and the other group being the one which constructed the farm carpentry project. The arc welding project group was given the small project method of instruction in arc welding and the drill method of instruction in farm carpentry. The carpentry project group was given the drill method of instruction in arc welding and the small project method in farm carpentry.

The individuals were assigned numbers for this study. Numbers 1 through 4 made up the arc welding project, carpentry drill group, and numbers 5 through 8 made up the arc welding drill, carpentry project group.

II. PROCEDURE

Lesson plans. The same lesson plans were used for both groups in order to cover the same material and giving equal time to each group for individual instruction.

The following lesson plans were used to cover the arc welding phases: (See Appendix A)

1. Determining the types of welders and electrical currents used in arc welding.
2. Classifying and selecting electrodes.
3. Selecting amperages to be used.
4. Setting up an arc welder.
5. Striking and holding an arc.
6. Determining the types of welds and positions.
7. Running a stringer bead in the flat position.
8. Preparing metal to be welded.
9. Making a butt, lap and "tee" weld in the flat

position.

Also, the following phases in farm carpentry were covered by lesson plans: (See Appendix B)

1. Determining the types and grades of lumber most commonly used on the farm.
2. Learning the hand tools used in farm carpentry.
3. Measuring and marking lumber to be cut.
4. Sawing lumber square with a cross-cut saw.
5. Laying out angles with a framing square.
6. Determining the fastening devices used in farm carpentry.
7. Fastening lumber.

Demonstrations. The students received demonstrations in all the mechanical phases of the unit as follows:

A. Arc Welding
   1. Setting up an arc welder.
   2. Striking and holding an arc.
   3. Running a stringer bead in the flat position.
   4. Making a butt, lap, and "tee" weld in the flat position.
B. Farm Carpentry
   1. Measuring and marking lumber to be cut.
   2. Sawing lumber square with a cross-cut saw.
   3. Laying out compound angles with a framing square.
   4. Sawing compound angles.

5. Fastening lumber.

<u>Practice</u>. Each of the groups were given fifteen hours in which to become proficient in the skills previously listed. The arc welding project group constructed a shoe scraper (See Appendix C) for their small arc welding project, to learn the basic arc welding skills. This group used the drill method in learning the farm carpentry skills. The carpentry project group constructed a sawhorse (See Appendix D) for their small farm carpentry project, for the development of the basic farm carpentry skills. This group used the drill method in learning the basic arc welding skills.

<u>Tests</u>. There was a pre-test and post-test given to each of the students. (See Appendix E) These two tests were the same, consisting of two parts. One part was an objective test in arc welding and farm carpentry and the second part was a mechanical performance test in arc welding and farm carpentry. The writer developed the arc welding and farm carpentry test which was used for the pre-test and post-test in the study. The questions were compiled from text-books, F.F.A. district agricultural mechanics contest tests and from tests previously used in the writers classes. The test was used for the North Central Kansas F.F.A. district agricultural mechanics contest in 1968.

<u>Scoring tests</u>. The industrial arts instructor

(See Appendix F) in the Washington Unified School District Number 222 graded the pre-tests and post-tests in arc welding and farm carpentry. The Farm Mechanics Text and Handbook, and Shopwork on the Farm was used for the construction and scoring of the tests.

The following scoring system was used to score the performance of each of the basic skills in arc welding.

Skill	Grade	Requirements for the grade
A. Setting up arc welder	1.	Welder incorrectly set up.
	2.	Welder correctly set up.
B. Selecting electrodes	1.	Selecting electrode not designed for the type of metal, incorrect size, incorrect electrode for type of weld, incorrect electrode for welding position.
	2.	One of the above correct.
	3.	Two of the above correct.
	4.	Three of the above correct.
	5.	All the above correct.
C. Selecting amperage	1.	Amperage incorrect by more than 30 ampers.
	2.	Amperage incorrect by 20 to 30 ampers.

Skill	Grade	Requirements for the grade
	3.	Amperage incorrect by 10 to 20 ampers.
	4.	Correct amperage.
D. Striking and holding an arc	1.	Strikes and holds an arc less than two times out of ten attempts.
	2.	Strikes and holds an arc two to four times out of ten attempts.
	3.	Strikes and holds an arc four to six times out of ten attempts.
	4.	Strikes and holds an arc six to eight times out of ten attempts.
	5.	Strikes and holds an arc eight to ten times out of ten attempts.
E. All welds	1.	Incorrect width, penetration, speed, and uniformity.
	2.	Any three incorrect.
	3.	Incorrect penetration and speed.

Skill	Grade	Requirements for the grade
	4.	Incorrect penetration.
	5.	All the above correct.

The following scoring system was used to score the performance of each of the basic skills in farm carpentry.

Skill	Grade	Requirements for the grade
A. Tool selection	1.	Less than two of the following tools correctly selected: Crosscut saw Framing square Jack plane Claw hammer Try or combination square
	2.	Two of the above tools correctly selected.
	3.	Three of the tools correctly selected.
	4.	Four of the tools correctly selected.
	5.	All the tools correctly selected.
B. Measurements	1.	Less than one correct measurement.
	2.	One measurement correct.

Skill	Grade	Requirements for the grade
	3.	Two measurements correct.
	4.	Three measurements correct.
	5.	All the measurements correct.
C. All other skills	1.	Four mistakes.
	2.	Three mistakes.
	3.	Two mistakes.
	4.	One mistake.
	5.	No mistakes.

CHAPTER IV

PRESENTATION OF DATA

The students selected one of two small projects (one in arc welding and one in farm carpentry) and were placed in one of the two groups. The two groups then were tested for equality. The following criterion factors were used:

1. The Intelligence Quotient Scores.
2. The students' grade point average at the end of the first semester of the 1967-68 school year.
3. The students' scores on the written pre-test on arc welding and farm carpentry.

The data in Table I shows that the Intelligence Quotients for the two groups ranged from 99 to 140. The average Intelligence Quotient for the arc welding project, carpentry drill group was 126.25. While the average Intelligence Quotient for the arc welding drill, carpentry project group was 118.25. This difference between the two groups in Intelligence Quotient was 8 per cent.

Based on a four point grading system, the arc welding project, carpentry drill group had an average grade point of 2.4 and the arc welding drill, carpentry project group had an average grade point of 1.6. This difference was a grade point difference of .8 of a grade point.

TABLE I

COMPARISON OF INTELLIGENCE QUOTIENTS, GRADE POINT AVERAGES AND WRITTEN PRE-TEST SCORES FOR THE ARC WELDING PROJECT, CARPENTRY DRILL AND ARC WELDING DRILL, CARPENTRY PROJECT GROUPS

Arc Welding Project, Carpentry Drill Group				Arc Welding Drill, Carpentry Project Group			
Individual	Intelligence Quotient	Grade Point Average[1]	Written Pre-test Per cent	Individual	Intelligence Quotient	Grade Point Average	Written Pre-test Per cent
1	117	1.5	64	5	136	2.4	60
2	140	3.5	52	6	99	1.0	44
3	116	1.25	52	7	112	1.25	70
4	132	3.5	64	8	126	2.0	66
Average	126.25	2.4	58	Average	118.25	1.6	60

[1]The grade point was figured on a 4 point system with 4 equalling an A and 1 equalling a D.

It was noted in a study of Table I that one of the individuals had an Intelligence Quotient below 100 or the average Intelligence Quotient and a grade point average of 1.0. It was also noted that three of the individuals had an Intelligence Quotient between 112 and 117 with grade point averages of 1.25, 1.25 and 1.5.

The last criterion factor which the groups were checked for equality was the written pre-test scores. The data in Table I shows that the group with the lowest average Intelligence Quotient and the lowest grade point average scored higher on the pre-test than did the group which had the higher average Intelligence Quotient and grade point. The arc welding project, carpentry drill group had an average score of 58 per cent. Two individuals had a score of 52 per cent and two had a score of 64 per cent. The arc welding drill, carpentry project group had an average score of 60 per cent. The data shows a 2 per cent difference between the two groups. When the results of the three criterion were considered the assumption was made that the difference between the groups were insufficient to hinder the study.

The data in Table II shows a difference between individuals in the study. Individual number 7 had the highest pre-test score of 70 per cent and his post-test score was 84 per cent. While individual number 2 had a pre-test score of 52 per cent and his post-test score was high with an 86 per cent. The data in Table I shows that individual number 2 had an Intelligence Quotient of 140 while individual number 7 had an Intelligence Quotient of 126. The grade point averages of the two individuals were 3.5 and 2.0 consecutively. The data in Tables I and II shows that the individual which had the lowest pre-test and post-test score had the lowest Intelligence Quotient and grade point average. Individual number 5, who had the second highest Intelligence Quotient of 136, had a pre-test score of 60 and a post-test score of 74 with an improvement of 14 per cent.

TABLE II

COMPARISON OF THE WRITTEN PRE-TEST AND POST-TEST SCORES FOR THE ARC WELDING PROJECT, CARPENTRY DRILL AND ARC WELDING DRILL, CARPENTRY PROJECT GROUP

Arc Welding Project, Carpentry Drill Group			Arc Welding Drill, Carpentry Project Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	64%	80%	5	60%	74%
2	52%	86%	6	44%	62%
3	52%	72%	7	70%	84%
4	64%	82%	8	66%	80%

The data in Table III shows that a pre-test score for all individuals was one. One being poorest and two being best. The post-test score for all the individuals was a perfect score of two. On this phase of the study the individual differences had no bearing on the ability of the individuals to set up an arc welder.

TABLE III

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON SETTING UP THE ARC WELDER[1]

Arc Welding Project Group			Arc Welding Drill Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	1*	2	5	1	2
2	1	2	6	1	2
3	1	2	7	1	2
4	1	2	8	1	2
Average	1	2	Average	1	2

*1 poorest and 2 best.

The data in Table IV shows that the pre-test scores for individuals range from 1 to 2, with a score of 1 poorest and 5 best. The post-test score for all the individuals was a perfect score of 5. Four individuals had a pre-test score of 2 and four individuals had a pre-test score of 1.

Both groups showed equal improvement, although there was individual differences within the groups (See Table IV).

[1]See grading system on page 16.

TABLE IV

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON THE SELECTION OF ELECTRODES

Arc Welding Project Group			Arc Welding Drill Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	2*	5	5	1	5
2	1	5	6	1	5
3	1	5	7	2	5
4	2	5	8	2	5
Average	1.5	5	Average	1.5	5

*1 poorest and 5 best.

The data in Table V shows there was difference of .25 of a point between the two groups. The arc welding project group had an average pre-test score of 1.25. Three of the individuals had a score of 1 and one individual had a score of 2. All four individuals had a score of 4 on the post-test.

The data in Table V shows that the average pre-test score for the arc welding drill group was 1.5 with two individuals having a score of 1 and two individuals having a score of 2. The individuals with a score of 2 had had no previous welding experience, therefore their score may have been due to an element of guessing.

TABLE V

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON AMPERAGE SELECTION

Arc Welding Project Group			Arc Welding Drill Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	1*	4	5	1	4
2	1	4	6	2	4
3	2	4	7	2	4
4	1	4	8	1	4
Average	1.25	4	Average	1.5	4

*1 poorest and 4 best.

The hypothesis of the study was that the group which constructed the project would excel the group which had the drill method of instruction. This hypothesis was not supported in any phase except in selecting amperage and this .25 difference as shown in Table V may have been due to an element of guessing rather than an increase in knowledge.

In the phase of striking the arc there was no difference between the project group and drill group. Table VI showed identical scores for both groups. Both groups had an average pre-test score of 2.5 and a post-test score of 5. Two individuals had a pre-test score two points higher than the other six individuals.

TABLE VI

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON STRIKING AN ARC

Arc Welding Project Group			Arc Welding Drill Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	4*	5	5	2	5
2	2	5	6	2	5
3	2	5	7	2	5
4	2	5	8	4	5
Average	2.5	5	Average	2.5	5

*1 poorest and 5 best.

Table VII shows that individuals 1 and 8 had a high pre-test score on ten of the fourteen skills tested. This may have been due to previous arc welding and carpentry experience at the time of the study. Individual one had an improvement of one point on all the skills tested except six. Three of the six skills were not testing mechanical ability, but were testing knowledge. Two of the skills he made no improvement and one he decreased in his ability. This decrease might have been due to carelessness in measuring and marking or either.

Individual eight had an improvement of one point on seven skills. He made no improvement on two skills. The

TABLE VII

THE MECHANICAL PRE-TEST AND POST-TEST SCORES FOR INDIVIDUAL NUMBER ONE AND INDIVIDUAL NUMBER EIGHT

	Individual One		Individual Eight	
Skill	Pre-test	Post-test	Pre-test	Post-test
Setting up the arc welder	1	2	1	2
Selection of electrodes	2	5	1	5
Selecting amperage	1	4	1	4
Striking an arc	4	5	4	5
Running a stringer bead	3	4	3	3
Making a butt weld	3	4	3	4
Making a lap weld	4	4	3	5
Making a "tee" weld	3	4	2	4
Tool selection	3	5	4	5
Measuring and marking lumber	4	3	2	4
Sawing lumber square	3	4	3	4
Sawing lumber at an angle	1	5	1	5
Glueing lumber	4	5	4	5
Nailing lumber	4	4	4	5

remaining five skills he had an improvement greater than one with four points being the greatest improvement on any one skill.

The data in Table VIII showed that the arc welding project group had an average pre-test score of 2 and the arc welding drill group had an average pre-test score of 2.25. Both groups had an average post-test score of 3.5. The data showed that the arc welding project group had a greater average improvement than did the arc welding drill group.

TABLE VIII

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON RUNNING A STRINGER BEAD

Arc Welding Project Group			Arc Welding Drill Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	3	4	5	2	4
2	1	4	6	2	4
3	2	3	7	2	3
4	2	3	8	3	3
Average	2	3.5	Average	2.25	3.5

The data in Table IX shows that individual six was consistently equal to or better than individual two on the mechanical tests in the study. Individual two had the highest Intelligence Quotient and highest grade point average (See Table I). He also has the highest written post-test score (See Table II). Individual six had the lowest Intelligence Quotient, grade point average and written post-test score. The data shows that an individual which had a lower Intelligence Quotient was not necessarily lower mechanically.

TABLE IX

THE MECHANICAL PRE-TEST AND POST-TEST SCORES FOR INDIVIDUALS TWO AND SIX ON THE ARC WELDING SKILLS

Skill	Individual Two		Individual Six	
	Pre-test	Post-test	Pre-test	Post-test
Setting up arc welder	1	2	1	2
Selection of electrodes	1	5	1	5
Selecting amperage	1	4	2	4
Striking an arc	2	5	2	5
Running a stringer bead	1	4	2	4
Making a butt weld	1	2	2	4
Making a lap weld	1	3	1	3
Making a "tee" weld	1	2	2	3

The data in Table X showed that the arc welding project group had an average pre-test score of 1.75. One individual had a score of 3, one individual had a score of 2, and two individuals had a pre-test score of 1. The individual which had a pre-test score of 3 had had previous welding experience on his home farm. One of the individuals which had a pre-test score of 1 is a town boy and the other individual has two older brothers who do all the repair and maintenance on the farm.

TABLE X

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES FOR MAKING A BUTT WELD

Arc Welding Project Group			Arc Welding Drill Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	3*	4	5	2	3
2	1	2	6	2	4
3	1	3	7	1	4
4	2	3	8	3	4
Average	1.75	3	Average	2	3.75

*1 poorest and 5 best.

The data showed that the arc welding drill group had an average pre-test score of 1.75. Two individuals, both town boys, had a pre-test score of 2. One individual had a score of 1 and one had a score of 3. The individual with the score of 3 also had had previous experience in welding in the home farm shop. The individual with the pre-test score of 1 lives with his grandparents and does not have facilities for a farm shop.

The arc welding project group had an average post-test score of 3, for making a butt weld, while the arc welding drill group had an average score of 3.75. Three individuals in the project group had an improvement of 1 point. One individual had an improvement of 2 points. The data in Table X showed that two individuals in the drill group had an improvement of 1 point. One individual had an improvement of 2 points and one individual had an improvement of 3 points. The drill group excelled the project group on this phase of the study.

The data shown in Table XI indicated a similar situation for making a lap weld as was for making a butt weld. The previous welding experience individuals had had showed an influence on the results of the study especially in the phases of performing the different kinds of welds. However, each of the two groups had only one individual with previous experience which tends to keep the groups equal.

The data in Table XI showed that the average pre-test score for the project group was 2 and the post-test score was 3.25. An improvement of 1.25 for the project group is less than an average improvement of 2 for the drill group. This difference shows evidence in favor of the drill method of instruction for this particular phase of arc welding. The drill group had an average pre-test score of 1.75 and an average post-test score of 3.75.

TABLE XI

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES FOR MAKING A LAP WELD

Arc Welding Project Group			Arc Welding Drill Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	4*	4	5	1	3
2	1	3	6	1	3
3	1	3	7	2	4
4	2	3	8	3	5
Average	2	3.25	Average	1.75	3.75

1* poorest and 5 best.

The results of the pre-test and post-test scores for making a "tee" weld showed no difference in the improvement between the arc welding project group and the arc welding drill group (See Table XII). However, there were differences between individuals in the study.

The data in Table XII showed that one individual in the project group had a pre-test score of 1, two individuals had a score of 2 and one individual had a score of 3. This difference in the individuals pre-test score may be an indication of the individual's natural mechanical ability in arc welding. The post-test scores for the project group indicated the same differences between individuals as does the scores of the pre-test. Also there was equal improvement of 1 point for all four individuals.

TABLE XII

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES FOR MAKING A "TEE" WELD

Arc Welding Project Group			Arc Welding Drill Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	3*	4	5	1	2
2	1	2	6	2	3
3	2	3	7	2	2
4	2	3	8	2	4
Average	2	3	Average	1.75	2.75

*1 poorest and 5 best.

The data showed a similar situation in the drill group on the pre-test. However, the differences between the individuals in the drill group is less than the differences in the project group. One individual had a pre-test score of 1 and three individuals had a score of 2. There was not an equal improvement for the individuals in the drill group. The data in Table XII showed that one individual showed no improvement, two individuals showed an improvement of 1 point and one individual had an improvement of 2 points. However, the improvement for both groups were equal which indicated that both methods, the project method and drill method, of instruction had equal results on this phase of arc welding.

In presenting the data on the farm carpentry skills the groups were reversed. The arc welding project group became the carpentry drill group and the arc welding drill group became the carpentry project group. This enabled both groups the opportunity to construct a small project which the writer assumed that a feeling of jealousy between the individuals in the study and the tendency of the writer to show favoritism toward either method of instruction would be avoided.

In studying the data in Table XIII the writer observed that all individuals in the study had a high pre-test score. Five individuals had a pre-test score of 4 and three individuals had a score of three. This data indicated the individuals had had previous experience in tool selection. The post-test scores were all a perfect score of 5.

The average improvement of the project group in Table XIII was .25 of a point greater than that of the drill group.

TABLE XIII

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON TOOL SELECTION

Carpentry Drill Group			Carpentry Project Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	3*	5	5	3	5
2	4	5	6	4	5
3	4	5	7	3	5
4	4	5	8	4	5
Average	3.75	5	Average	3.50	5

*1 poorest and 5 best.

The data in Table XIV shows that the carpentry drill group had an average pre-test score of 2.25 and a post-test score of 4. The carpentry project group had an average pre-test score of 2.25 and a post-stest score of 4.25. The average improvement was .25 of a point greater for the project group. Table XIV shows that individual one had a pre-test score of 4 and a post-test score of 3 which indicated to the writer that he might have been careless on the post-test. The difference in average improvement between the groups may have been due to carelessness rather than a greater increase in knowledge.

TABLE XIV

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON MEASURING AND MARKING LUMBER

Carpentry Drill Group			Carpentry Project Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	4*	3	5	4	4
2	3	4	6	1	4
3	1	5	7	2	5
4	1	4	8	2	4
Average	2.25	4	Average	2.25	4.25

*1 poorest and 5 best.

The data in Table XV shows there was an average improvement difference of .5 of a point.

In Table XV the data shows that individuals 2, 4, 5 and 6 had a post-test score of 3 while individuals 1, 3, 7 and 8 had a post-test score of 4. Individuals 2, 4 and 5 had the three highest Intelligence Quotients of 140, 132 and 136 (See Table I). Individual 6 had the lowest Intelligence Quotient of 99. The other individuals all had a post-test score of 4. While two of the high Intelligence Quotient individuals had a greater improvement, their final work was inferior to that of the individuals whose Intelligence Quotients were nearer to the average Intelligence Quotients for both groups.

TABLE XV

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON SAWING LUMBER SQUARE

Carpentry Drill Group			Carpentry Project Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	3*	4	5	2	3
2	1	3	6	2	3
3	3	4	7	3	4
4	1	3	8	3	4
Average	2	3.50	Average	2.50	3.50

*1 poorest and 5 best.

In performing the skill of sawing lumber at an angle all individuals were equal on the pre-test. On the post-test all the individuals had a score of 5 except one who had a score of 3 (See Table XVI).

In Table XVI it appears that individual 7 had trouble in either laying out the angles or in sawing lumber. His post-test score on sawing lumber square (Table XV) indicated to the writer the problem was on the use of a framing square in laying out the angle.

The data in Table XVI indicated that the individuals had had no previous experience in sawing angles. The pre-test scores for the individuals were 1. On this particular skill both groups showed the greatest amount of improvement than on any other skill in the study.

TABLE XVI

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON SAWING LUMBER AT AN ANGLE

Carpentry Drill Group			Carpentry Project Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	1*	5	5	1	5
2	1	5	6	1	5
3	1	5	7	1	3
4	1	5	8	1	5
Average	1	5	Average	1	4.50

*1 poorest and 5 best.

The data in Table XVII shows that the drill group had a higher average pre-test and post-test score than did the project group. The drill group had an average pre-test score of 3.75 and an average post-test score of 4.75. The average improvement for the group was 1.

The data showed that the project group had an average pre-test score of 3.5 and an average post-test score of 4.5. This group also had an average improvement of 1. Therefore the groups, the drill group and the project group, improved equally.

TABLE XVII

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON GLUING LUMBER

Carpentry Drill Group			Carpentry Project Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	4*	5	5	3	4
2	4	5	6	4	5
3	3	4	7	4	5
4	4	5	8	4	5
Average	3.75	4.75	Average	3.50	4.50

*1 poorest and 5 best.

The data in Table XVIII indicated the individuals in the study have had experience using the claw hammer and nailing lumber. There were two individuals who had perfect scores of 5 on the pre-test for nailing lumber and six individuals had a score of 4.

The data showed that both groups were equal. Both groups had an average pre-test score of 4.25. One individual in each group had a score of 5 and three individuals had a score of 4. The post-test scores for both groups were also indentical. Two scores of 5 and two scores of 4.

The data showed evidence on this skill that either method of instruction, the small project method or the drill method, was equally as effective.

TABLE XVIII

COMPARISON OF MECHANICAL PRE-TEST AND POST-TEST SCORES ON NAILING LUMBER

Carpentry Drill Group			Carpentry Project Group		
Individual	Pre-test	Post-test	Individual	Pre-test	Post-test
1	4*	4	5	4	4
2	4	4	6	4	4
3	5	5	7	5	5
4	4	5	8	4	5
Average	4.25	4.5	Average	4.25	4.5

*1 poorest and 5 best.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

I. SUMMARY

The purpose of this study was to compare the small project and the drill method of instruction for agricultural mechanics skill development.

The primary objective was to determine the difference in improvement of skill development by implementing two methods of instruction, the project method and the drill method.

The writer hypothesized that the group which received the small project method of instruction would exceed the accomplishments of the group which received the drill method.

In conducting this study the writer realized several limitations. The limitation which seemed to affect the study the greatest was that there were only four subjects in each group. The differences found in the study was not significant due to the small number in each group.

The students in the 1967-68 Vocational Agriculture One class, Washington High School, were used in the study. The students were given an opportunity to select one of two small projects (one in arc welding or one in farm carpentry). The selection of the project placed them into one of two groups, the arc welding project, carpentry drill group, or the arc welding drill, carpentry project group.

The same lesson plans were used for both groups, thus allowing equal time to each group. The groups were allowed fifteen hours in which to become proficient in the selected arc welding and carpentry skills.

The students in each group were given a pre-test and a post-test in arc welding and farm carpentry. The data gathered from the pre-test and post-test was used in determining the amount of improvement for each group.

Three criterion factors were used to check the two groups for equality. It was found that the groups had an 8 per cent difference in average Intelligence Quotient. The data found that grade point averages also indicated a difference of .8 of a point on a 4 point grading system. Both the Intelligence Quotient and grade point average indicated the arc welding project, carpentry drill group surpassed the arc welding drill, carpentry project group.

The average written pre-test score indicated the arc welding drill, carpentry project group exceeded the arc welding project, carpentry drill group by 2 per cent. The writer assumed the differences insufficient to hinder the study.

There was an indication that two individuals in the study had had previous welding experience. Individual number 1 in the arc welding project group and individual number 8 in the arc welding drill group consistently scored higher on the pre-test for the mechanical skills in arc welding. The previous welding experience the two individuals may have had an affect on the results of the study.

The data found showed that neither the arc welding project, carpentry drill group nor the arc welding drill, carpentry project group excelled in all the skills tested. The results of the pre-test and post-test showed that the arc welding project group had greater improvement on two skills tested, selecting amperage and running a stringer bead. The arc welding drill group exceeded the arc welding project group on two skills, making a butt weld and making a lap weld. The two groups were equal on the other arc welding skills.

The data showed that the carpentry drill group exceeded the carpentry prõject group on two skills, sawing lumber square and sawing lumber at an angle. The project group exceeded the drill group on tool selection and measuring and marking lumber. The two groups were equal on the remaining two skills, gluing and nailing lumber.

II. CONCLUSION

After reviewing the data gathered from the study the writer concluded, that either method, the small project method or the drill method of instruction for agricultural mechanics skill development was an acceptable method for the 1967-68 Vocational Agriculture One class in the Washington High School. No differences appeared in the accomplishments of the two groups.

III. RECOMMENDATIONS

If another study on the comparison of the project method and drill method of agricultural mechanics instruction is to be conducted, the writer recommended the following:

1. The comparison of the small project method, drill method, and a combination of both methods of instruction be conducted.
2. The study be made using three groups located in different vocational agriculture departments.
3. A comparison of high, average and low achievers be conducted on the proficiency in agricultural mechanics skill development.

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APPENDIX A

SELECTED ARC WELDING LESSON PLANS

AREA: Agricultural Mechanics

UNIT: Arc Welding

LESSON: Determining the types of electrical currents used for arc welding and the types of welders.

OBJECTIVE: To become familiar with welding units and the currents used in welding.

MOTIVATION: When purchasing a welder a farmer should consider the purpose for the welder and where he will use the welder the most. After he has decided what and where he plans to do most of his welding he must be familiar with the types of welders and welding currents.

REFERENCE: ______________, New Lessons in Arc Welding (Cleveland: The Lincoln Electric Company, 1965).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Types of current	1.1 Arc welding requires a continuous supply of electric current. This current must be sufficient in amperage and of proper voltage to maintain an arc.
	1.2 The current used in arc welding may be either alternating or direct current but it must be provided through a source which can be controlled.

2.	Types of welding machines	2.1	The type of welding machine will determine the type of current produced. Alternating current is produced in special welding transformers. This represents a transformer welder.
		2.2	Direct current is produced in either electric molar-generator units, rectifier sets, or engine-driven generator sets.
		2.3	Both alternating and direct currents are produced by a transformer rectifier unit.
3.	Rating	3.1	Welding machines are rated according to their current output. The range from 100 ampere machines used on 115V circuits to 1200 amperes or more for automatic equipment. This rating is set by manufacturers in accordance with standards established by the National Electrical Manufacturers Association.
		3.2	The standards are established on a conservative basis, requiring

a rating well below the maximum overload capacity of the machine.

3.3 Ratings are given with a percentage duty cycle. The duty cycle of a welder is the percentage of a ten minute period that a welder can operate at a given output current setting.

AREA: Agricultural Mechanics

UNIT: Arc Welding

LESSON: Classifying and selecting electrodes.

OBJECTIVE: To learn the how electrodes are classified and what common electrodes are used in farm welding.

MOTIVATION: Every welding operator must have a knowledge of kinds and types of electrodes since each successful welding operation is dependent upon the selection of the correct electrode for the job.

REFERENCE: Harold L. Kugler, Arc Welding Lessons for School and Farm Shop (Cleveland: The James F. Lincoln Arc Welding Foundation, 1950).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Coatings	1.1 The first electrodes used were bare steel wire rods. Through continued research it was discovered that by adding a chemical coating to the bare steel wire, the welding characteristics of the arc and qualities of the finished weld were improved.
	1.2 Welding with coated electrodes commonly is referred to as the "shielded arc" process of welding.

	1.3	The coatings on electrodes are commonly made up of sodium silicate. Each ingredient in the mixture has a particular purpose when used as part of the coating.
2. Polarity	2.1	Electrodes are classified by manufacturers in accordance with the Standard American Welding Society specifications.
	2.2	Polarity is one of the factors considered in this classification.
	2.3	Polarity is not involved in operation of A.C. welders but is very important when using D.C. welders. Polarity is a term used which means the direction in which current flows through a conductor.
	2.4	Straight or negative polarity means the electrode is negative and reverse or positive polarity the electrode is positive.
3. Electrode size	3.1	The size of an electrode refers

to the diameter of the steel core not the diameter of the core and coating.

3.2 The common sizes of electrodes used in farm welding are 1/8 and 5/32 inch. Small quantities of 3/32 and 3/16 inch are kept for special jobs.

4. Electrode classification

4.1 Through joint action of the American Society for Testing Materials, electrodes have been classified into types according to the metal to be welded.

4.2 A classification number is the standard method of classifying electrodes. E 6013 - The E stands for metal arc welding electrode. The first two digits in the number designate the minimum allowable tensile strength of the deposite weld metal in thousands of pounds per square inch. The third digit explains the possible welding positions. A 1 as the third digit indicates the electrode can be used in flat, vertical, overhead and horizontal positions; 2 restricts the use of the electrode to horizontal and flat position, while 3 indicates the electrode will give best results in the flat position. The fourth digit is considered as subgrade and is used for the purpose of identification.

5. Color code	5.1 Another way electrodes are classified is by a color code. This color code is not as common as number classifications.
6. Selection	6.1 A general rule of electrode selection is that the electrode diameter should not exceed the thickness of the base metal.

AREA: Agricultural Mechanics

UNIT: Arc Welding

LESSON: Selecting amperage

OBJECTIVE: To become proficient in selecting the correct amperage for the job.

MOTIVATION: A good welder selects the correct amperage in order to insure correct penetration and maximum weld out of the electrode. Also correct amperage affects the strength of the weld.

REFERENCES: _________, Forney Arc Welding Manual (Fort Collins: Don-Art Printers, Inc., 1965).

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Harold L. Kugler, Arc Welding Lessons for School and Farm Shop (Cleveland: The Jones F. Lincoln Arc Welding Foundation, 1950).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Factors	1.1 There are basically three factors which determine the amperage needed which are: a. electrode classification b. electrode size c. metal thickness
2. Electrode classification	2.1 The class of electrode will determine the amount of heat to

use. For example an E 6011 and E 6013 require different amperage settings for best results. There are no definite amperage setting but must be determined by trial and error.

3. Electrode size

3.1 Different size electrodes require different amperage settings. The following chart gives the amperage range for an E 6013 electrode of different sizes.

Electrode Size	Amperage Range
1/16"	20-40
3/32"	30-80
1/8"	70-120
5/32"	120-170
3/16"	140-240

4. Thickness of metal

4.1 A general rule to remember when welding different thicknesses of metal is, the thicker the metal the higher the amperage.

4.2 The following chart is a handy chart which helps the beginning welder select the approximate amperage:

	Rod Sizes	5/64	3/32	1/8	5/32	3/16
Metal thickness	22 ga.	20	20	Approximate Amperes		
	1/16	30	30			
	1/8		65	80	90	
	3/16			105	140	150
	1/4			130	150	170
	Over 5/16			140	170	180

AREA: Agricultural Mechanics

UNIT: Arc Welding

LESSON: Setting up arc welder

OBJECTIVE: To learn how to set up an arc welder.

STEPS	PROCEDURE
1. Secure equipment	1.1 Secure an arc welder, welding cables, electrode holder, ground clamp, and welders helmet.
2. Connect ground clamp	2.1 Connect the shortest welding cable, which usually had the ground clamp fastened to one end, to the power source at the location marked ground or "to work." Connect the clamp to the base metal making sure there is a good connection.
3. Connect electrode holder	3.1 Connect the longest cable, which usually has the electrode fastened to one end, to the terminal marked, positive or "to electrode."
4. Select amperage	4.1 Select the correct amperage by turning indicator knob or dial type selectors or by plugging electrode holder cable into

			desired amperage plug on plug type welders.
5.	Helmet	5.1	Fit head band on helmet to your head before turning on welder.
6.	Switch	6.1	Turn switch to on position and test welder for an arc before starting to weld.

AREA: Agricultural Mechanics

UNIT: Arc Welding

LESSON: Striking an arc and running a stringer bead.

OBJECTIVE: To learn the methods of striking an arc. To learn the correct method of running a stringer bead.

MOTIVATION: The first skill a welder must learn is striking an arc and running a stringer bead. In order to do this a student must learn the methods of performing the basic skills.

REFERENCE: Harold L. Kugler, Arc Welding Lessons for School and Farm Shop (Cleveland: The Jones F. Lincoln Arc Welding Foundation, 1950).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Striking the arc	1.1 There is two acceptable methods of striking an arc which are: a. tapping b. scratching
	1.2 The tapping method of striking the arc commonly is used when the arc is broken while welding and it is necessary to restart the arc immediately.
	1.3 When the tapping method is used the electrode is moved toward the work in a vertical direction.

As soon as it touches the metal it is withdrawn to the correct arc length.

1.4 The scratching method of striking the arc is used when striking an arc for the first time with a new or used cold electrode.

1.5 When the scratching method is used the electrode is moved at an angle to the plate in a scratching motion (like striking a match). The electrode is raised to an arc length of about 1/8 inch after contact is made with the metal, then the electrode is moved to the starting point and at the proper arc length.

2. Arc length

2.1 The term "arc length" is defined as the distance between the end of the steel core of the electrode and the surface metal in the bottom of the crater.

2.2 The correct arc length is equal approximately to the diameter

			of the bore end of the electrode and is measured from the base of the crater to the tip-end of the steel core wire.
		2.3	When the correct arc length has been established, the arc will give off a sharp crackling sound similar to bacon frying.
3.	Holding the electrode	3.1	The electrode should be held in a position of 90 degrees when viewed from the end and at an angle of 15 to 25 degrees in the direction of travel when viewed from the side.
4.	Speed of travel	4.1	The correct speed can be judged by the thickness and smoothness of the bead. The bead should be 1 1/2 to 2 times the diameter of the electrode core.
		4.2	One method of obtaining this correct speed is, when the electrode is held at the proper position and the arc length is established allow the hand holding the electrode holder to drop straight

down. Thus as the electrode melts the bead will move forward.

5.	Other factors to consider	5.1	Other factors which should be considered when running a stringer bead are the selection of electrodes and amperage.

AREA: Agriculture Mechanics

UNIT: Arc Welding

LESSON: Making a butt weld in the flat position.

OBJECTIVE: To determine the methods of preparing metal and butt welding.

MOTIVATION: The type of weld most commonly used in arc welding is the butt weld. In order for a student to become proficient in farm welding he must understand the types of butt joints and methods of preparing the metal for maximum strength.

REFERENCE: Harold L. Kugler, Arc Welding Lessons for School and Farm Shop (Cleveland: The James F. Lincoln Arc Welding Foundation, 1950).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Types of butt joints	1.1 There are three main butt joints which are: a. closed butt b. open butt c. vee butt
	1.2 The closed square butt joint is the type of joint obtained when two pieces of metal are placed end to end.
	1.3 The open butt joint is similar to the closed butt joint except

the pieces of metal being welded are moved apart a distance of 3/32 to 1/8 inch.

1.4 Whenever it is not possible to make one of the other butt welds and welding on both sides the Vee butt joint can be used to be sure of full penetration. The edges of the metal are beveled. The included angle must not exceed 60 degrees since the volume in the cross section area of the metal is to be kept as small as possible in order to limit the contraction which takes place when the metal cools.

1.5 There are three basic types of Vee butt joints which are:

a. The feather edge--the bevel carries completely through the metal.

b. The shoulder edge--the bevel is made leaving about 3/32" shoulder on the bottom of metal.

c. Double Vee--both sides of the metal is beveled at an included angle of 60 degrees leaving about 3/32" between each beveled side.

2. Methods of welding

2.1 There are three methods of welding butt joints.

a. single pass low amperage

b. single pass high amperage

c. multiple pass.

2.2 Single pass low amperage may be used on the closed and open butt joint but normally the metal must be welded from both sides to secure complete fusion of the two pieces of metal being welded. It is normally used when welding the Vee butt weld.

2.3 The single pass high amperage weld is used when only one side may be welded and complete fusion is needed.

2.4 The multiple pass weld is used on Vee butt joint in order to fill the Vee made by beveling.

3. Running the bead	3.1	The method of running a bead on a butt joint in the flat position is the same as running a stringer bead except the two pieces of metal are tacked at both ends before running bead.

AREA: Agricultural Mechanics

UNIT: Arc Welding

LESSON: Making a lap and "tee" weld.

OBJECTIVE: To learn the methods used for lap and "tee" welds.

MOTIVATION: When ever excessive strength is needed the welder must know how to make the lap joint and when welding braces on farm equipment the "tee" weld is commonly used.

REFERENCE: Harold L. Kugler, Arc Welding Lesson for School and Farm Shop (Cleveland: The James F. Lincoln Arc Welding Foundation, 1950).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Fillet weld	1.1 The term "fillet weld" as used in this operation refers to a weld placed in the included *angle formed when two pieces* of metal are joined together.
2. Lap weld	2.1 The lap weld is a fillet weld made by laping one piece of metal over another and the weld made at the end of the lapping pieces.
3. "Tee" weld	3.1 The "tee" weld is a fillet weld made by one piece of metal

being placed perpendicular to another and then welded at the 90 degree angle formed.

4.	Position of electrode	4.1	A short arc is maintained when making fillet welds to prevent undercutting. An arc length of approximately 1/2 the electrode diameter is considered the correct length.
		4.2	The electrode is held at an angle of approximately 45 degrees when viewing from end and at the same 15 to 25 degree angle when viewing from the side.
		4.3	The deposite metal should penetrate both pieces of metal equally, therefore the vertical angle may vary when two pieces of different thicknesses are being welded. The arc should be directed at the thickest piece.
5.	Amperage setting	5.1	When making a fillet weld the amperage should be increased

		slightly.
6. Multiple pass	6.1	When additional strength in a fillet weld is needed an operator may make a multiple pass weld thus tying a larger area together.

APPENDIX B

SELECTED FARM CARPENTRY LESSON PLANS

AREA: Agricultural Mechanics

UNIT: Farm Carpentry

LESSON: Determining the types and grades of lumber most commonly used on the farm.

OBJECTIVES: To become acquainted with the types and grades of lumber.

MOTIVATION: There are a great number of jobs on the farm which require the use of lumber. Some of these jobs are in the farm home, some are in the construction of fences and other livestock handling equipment. Still another use is the construction of farm buildings. With this great difference in uses for lumber, it would not be economically feasible to use the same type and grade of lumber.

REFERENCES: Mack M. Jones, Shopwork on the Farm (New York, McGraw-Hill Book Company, Inc., 1955).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Types of lumber	1.1 Lumber is classified and graded on such properties as strength, stiffness, hardness, toughness, freedom from warping, ease of working, nail-holding power, wear resistance, decay resistance, paint-holding power and

appearance.

1.2 Basically lumber is classified into two general classes: softwood, or lumber cut from needle-leaf evergreen trees, such as pine, fir and cypress; and hardwood, or lumber cut from broadleaf trees which shed their leaves, such as oak, hickory, and maple.

2. Uses

2.1 Softwoods are in more general use for building construction. Southern yellow pine and douglas fir are most widely used for construction work.

2.2 Hardwoods are generally used for work like tool and implement handles, floors and furniture. The most common hardwood used is oak.

3. Grades

3.1 Softwood lumber is classified into various grades on the basis of the size, kind, and number of defects present.

3.2 There are two general

classifications.

(a) select lumber

(b) common lumber.

3.3 Select lumber is suitable for finishing or painting; common lumber has certain defects which detract from its appearance, but is suitable for general utility and construction purposes.

3.4 Common lumber is most commonly used on the farm and is classified into two general classes, those which can be used without waste and those which require some cutting and waste.

3.5 The grades of common lumber are as follows:

(a) No. 1 Common (considered watertight)

(b) No. 2 Common (considered graintight)

(c) No. 3 Common (occasional knothole)

(d) No. 4 Common (low quality

lumber admitting the coarsest defects, such as decay and holes)

(e) No. 5 Common (must hold together under ordinary handling).

AREA: Agricultural Mechanics

UNIT: Farm Carpentry

LESSON: Learning the hand tools used in farm carpentry.

OBJECTIVES: To become familiar with the basic farm carpentry tools. To learn the correct tool for a particular job.

MOTIVATION: In order to display the finest workmanship, the worker must know what the name of the tools is and where and how they are used. The greatest problem in farm carpentry is the use of improper tools for a job, which may cost the farmer extra money or it may cause an accident.

REFERENCE: Mack M. Jones, Shopwork on the Farm (New York: McGraw-Hill Book Company, Inc., 1955).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Measuring tools	1.1 The most common measuring tools are the two foot folding rule, the zig-zag-type folding rule, the steel tape and the square.
	1.2 The try square, combination square, framing square and the sliding-tee-bevel square are commonly used in measuring and squaring lumber.
2. Saws	2.1 The common saws used on the

		farm are the crosscut saw, rip saw and the compass saw.
	2.2	The crosscut saw is used to cut across the grain of the lumber. The cutting edge of the teeth on a crosscut saw are leaning 15° toward the handle. The rip saw is used to cut with the grain and the cutting edge of their teeth are perpendicular to the tooth line.
	2.3	The compass saw is used to cut curved surfaces and is not as often used as the crosscut and rip saw.
3. Other cutting tools	3.1	The other cutting tools commonly found on the farm are the plane and the wood chisel. These tools are used for shaping and smoothing.
	3.2	Other smoothing tools found on the farm are the draw knife and the wood file or rasp.
4. Boring tools	4.1	The most common boring tool

used in farm carpentry is the electric drill and twist drills. Other tools used are the bit brace, hand drill and the automatic push drill.

4.2 The common boring bits used in boring are the twist drill and the auger bit. Other types are sometimes used which are the expansion bit and the countersink.

5. Hammers

5.1 The most common hammer used in carpentry is the claw hammer. This hammer comes in different weights for ease of driving different size nails.

5.2 Another hammer used in carpentry is the tack hammer.

AREA: Agricultural Mechanics

UNIT: Farm Carpentry

LESSON: Measuring and marking lumber to be cut.

OBJECTIVES: To learn the methods of using measuring tools. To determine the devices used to mark lumber.

MOTIVATION: One of the most important skills in farm carpentry is accurate measurements and marking. In order to become proficient in these skills you should know the graduations and methods of using the measuring and marking tools.

REFERENCES: Mack M. Jones, Shopwork on the Farm (New York: McGraw-Hill Book Company, Inc., 1955).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Graduations	1.1 The longest lines on a rule are 1 in. lines; the 1/2 in. lines are a little shorter; the 1/4 in. lines still shorter, etc. The smallest division on most rules used in farm carpentry is 1/16 in.
2. Reading the rule	2.1 When reading a fractional measurement with a rule, think of the measurement as a major fraction plus or minus a small fraction.

3. Measuring with steel tape	3.1 When using a steel tape, place hook on end of material and read directly at the desired length on the tape.
	3.2 When measuring between two pieces of material, place the hook against one side and the case on the other side, read the tape at the cast slot and add 2 inches.
4. Measuring with rule	4.1 Most rules are worn on the ends so place the 1 in. mark at the end of the material and read the mark at desired point and subtract 1 in.
5. Locating the center of a board	5.1 Place a rule or angle on the board so the edges are on one inch lines and then divide this distance by two, thus locating the center. If more equal divisions are needed, just divide by the number of lines needed.
6. Measuring angles	6.1 There are three basic tools used to measure angles. These

tools are the combination square used to measure 45° angles; the framing square used to measure angles expressed in pitch, and the sliding "Tee" bevel square used to measure and duplicate any angle.

6.2 Pitch is expressing angles in fractions such as 1/3, 2/3, etc.

$$\text{Pitch} = \frac{\text{rise}}{\text{2Xrun}}$$

Rise is the distance a roof rises per foot of run.

6.3 To lay out an angle with the framing square, place the numerator on the tongue of the square and the denominator on the blade and mark along the tongue.

7. Marking

7.1 A sharp pencil or a knife should be used for marking lumber.

7.2 Other marking devices are the marking guage used to mark a line parallel to the edge of a board, and the combination square to mark a line parallel to the edge of a board usually for just a short distance.

AREA: Agricultural Mechanics

UNIT: Farm Carpentry

LESSON: Using hand saws to saw lumber.

OBJECTIVE: To learn the proper method of using the hand saw.

MOTIVATION: After accurate measurements have been made, a skilled worker must be able to cut a board square and to measurement. Improper sawing is one of the most common mistakes in farm carpentry.

REFERENCE: Mack M. Jones, Shopwork on the Farm (New York: McGraw-Hill Book Company, Inc., 1955).

STEPS	PROCEDURE
1. Holding the saw	1.1 Grasp the handle of the saw firmly. Let the forefinger extend along the side of the handle and not through the handle with the other fingers. This enables you to control the saw more accurately.
	1.2 Stand back from the work a little and in a position so that a line across the chest and shoulders is at an angle of about 45° to 60° with the line

of sawing.

1.3 Place the saw, arm, elbow, shoulder, and right eye on the same vertical plane. In this position the saw can be more easily controlled and made to follow a straight line and cut perpendicular to the surface of the board.

1.4 For crosscutting, the saw should be held at a 45° angle to the surface of the board. For ripping, the saw should be held at a 60° angle to the surface of the board.

2. Starting the saw

2.1 The lumber to be cut should be held firmly in a vice or on a sawhorse with the left knee. Grasp the far edge of the board with the left hand, using the thumb to guide the saw while starting the cut.

2.2 Make two or three backstrokes lifting the saw on the forward strokes. Draw the saw back

		slowly and carefully just where the cut is to be made.
	2.3	Start the saw beside the line so the saw cut, or kerf is in the waste material.
3. Sawing off a board	3.1	After the saw is started push it forward and pull it back using long easy strokes and light pressure. Do not work too fast. Short, fast, choppy strokes are signs of an amateur or careless workman.
4. Safety tips	4.1	Always use a sharp, properly set saw and keep the saw free of gum and rust.

AREA: Agricultural Mechanics

UNIT: Farm Carpentry

LESSON: Laying out angles with a framing square.

OBJECTIVE: To learn how to use the framing square in laying out angles.

MOTIVATION: Many times a carpenter must lay out angles of different degrees. In order to lay them out he must understand how the angles are determined and their exact location.

REFERENCES: L. Perth, The Steel Square (New Britain: Stanley Tools, Division of the Stanley Works, 1949).

Mack M. Jones, Shopwork on the Farm (New York: McGraw-Hill Book Company, Inc., 1955).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. The square	1.1 The framing square is a simple calculating device used as a quick solution for problems in laying out work.
	1.2 The square is made in the form of a right angle. The two legs of the right angle are called the body and tongue.
	1.3 The body of the square is 24 inches long and 2 inches wide,

while the tongue is 16 inches long and 1 1/2 inches wide.

1.4 The heel is the point at which the body and tongue meet on the outside edge of the square.

1.5 The face of the square is the side which is visible, while holding the body in the left hand and tongue in the right hand. The opposite side is called the back.

1.6 Both the tongue and body are graduated on both inside and outside. The face and back are both graduated for fast easy reading.

2. Angles

2.1 The angles which can be laid out with a framing square are based on the length of the two sides of a 90° triangle. These angles are usually expressed in fractions.

2.2 The fractions are based on the rise to span. Rise equals the length of the vertical leg of the right triangle and span equals the length of the horizontal leg of the right triangle.

2.3 In carpentry most angles figured and laid out with the framing square are referred to as pitch. Pitch being the angle of a roof. At the point where a line drawn from the highest point of the roof perpendicular to the span, to the outside edge of the sidewall is called the run.

2.4 The formula for finding pitch is: Pitch = Rise divided by the Span.

3. Laying out pitch

3.1 When laying out pitch on the framing square the tongue is used for the run and the larger is used for the rise.

Rise per foot of run and square settings for common pitches.

Pitch	Rise	Square Setting
1/8	3"	3 and 12
1/6	4"	4 and 12

Pitch	Rise	Square Setting
1/4	6"	6 and 12
1/3	8"	8 and 12
1/2	12"	12 and 12

4. Example: to cut a rafter tie

4.1 The pitch of the roof is unknown but the building is 20 feet wide and the rise of the roof is 5 feet. What is the pitch and what settings would be used on the square to lay out the rafter tie.

Formula: $P = \frac{R}{S}$ $P = \frac{5}{20}$

$P = \frac{1}{4}$

If the pitch is 1/4 then the settings on the square would be 6 on the body and 12 on the tongue.

AREA: Agricultural Mechanics

UNIT: Farm Carpentry

LESSON: Learning the common fastening methods and how to use them.

OBJECTIVE: To learn the correct method of fastening lumber.

MOTIVATION: After a worker has completed all other operations in preparing a project, he has to assemble and fasten the parts into one item. In order to fasten all the parts in an economic and attractive manner, the worker must know the types of fastening methods and how to use them.

REFERENCE: Lloyd J. Phipps, and others, Farm Mechanics Text and Handbook (Danville: The Interstate Printers and Publishers, Inc., 1963).

THINGS I NEED TO KNOW	NECESSARY INFORMATION
1. Types of fasteners	1.1 The common types of fasteners are nails, screws, bolts and glue.
	1.2 The most often used fastener on the farm is nails.
2. Nails	2.1 The common types of nails are common, box, shingle, roofing, flooring, and finish nails.
	2.2 The common and box nail are more common the farm than the

		others. The sizes of the nails are designated by the "penny" (d) and range from 2d to 20d.
	2.3	Finish nails are used where the head is to be consealed.
3. Screws	3.1	The common types of screws are the lag or coach, flat head, round head, and oval head. The flat headed wood screw is the type most frequently used. Screws are sized by their length and diameter of the shank and are designated by a number and their length.
	3.2	Lay screws are used when a great deal of holding power is needed. They are also sized by their diameter and length.
4. Bolts	4.1	There are three main types of bolts used in woodwork which are: (1) Stove bolt, (2) Carriage, and (3) Machine.
	4.2	Bolts are also sized by their diameters and lengths.

4.3 Locking devices are sometimes used with bolts. Two common locking devices are the lock washer and the self-locking nut.

5. Glue

5.1 The most common glue used in farm carpentry is casein glue. it is very resistant to heat, cold, and high humidity when not exposed to the weather.

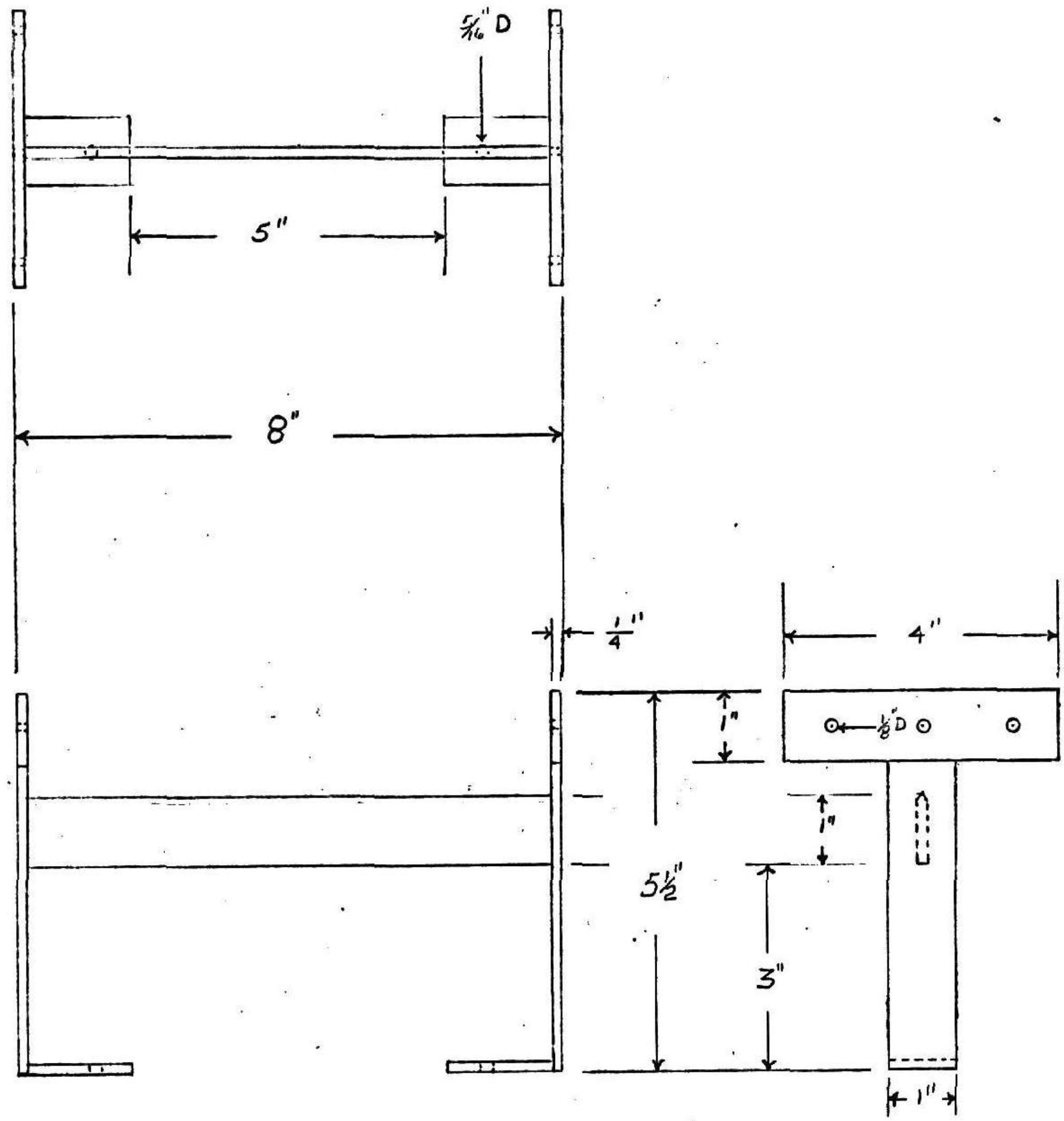
5.2 Glue should be spread on both pieces of wood being joined together. Then they should be nailed or bolted to hold them in place until the glue sets. A good glue joint is stronger than the wood itself.

5.3 Glue should be used whenever there is a need for extra strength due to heavy use and abuse.

APPENDIX C

SHOESCRAPER

PLATE ONE

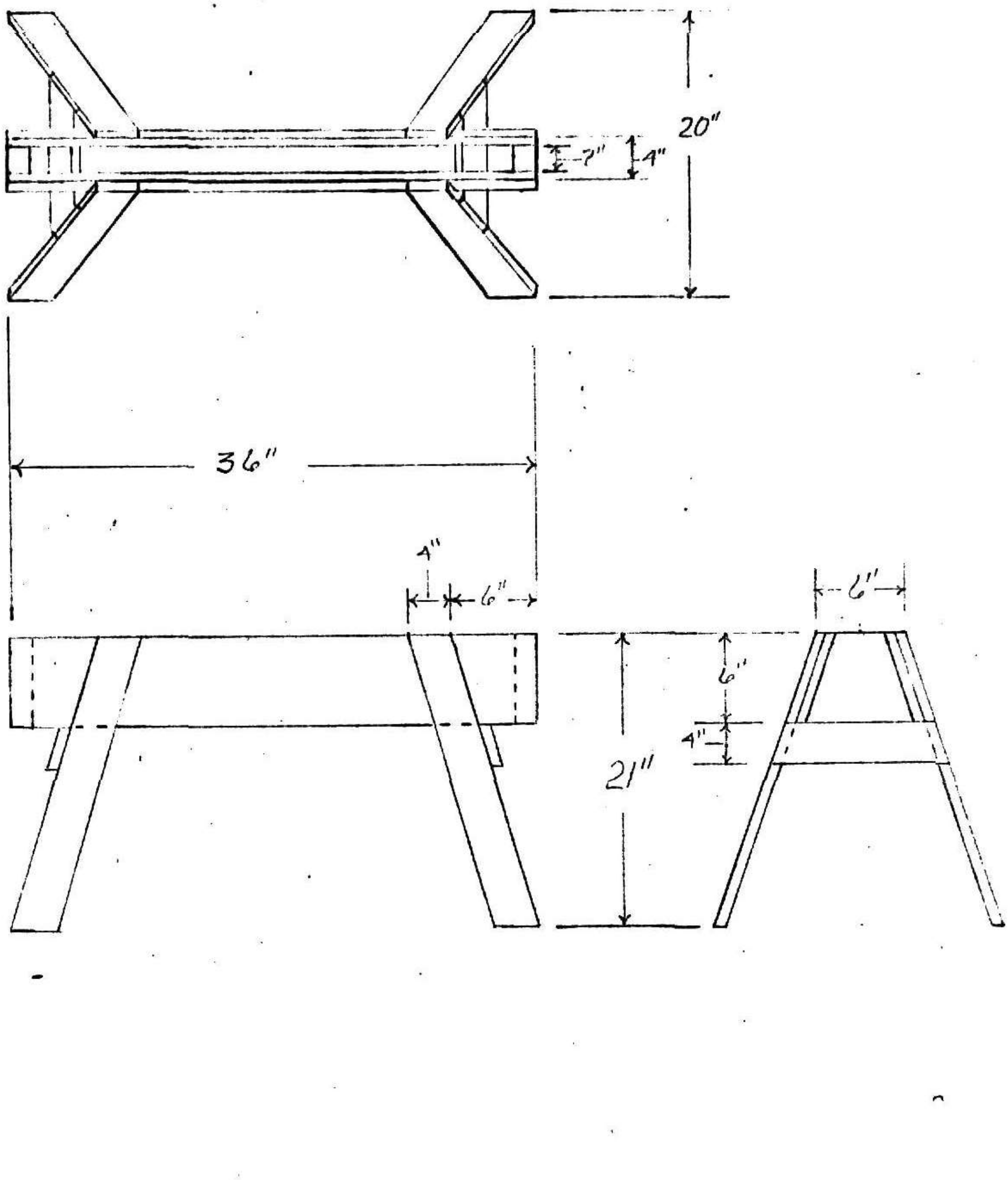


VOC. AG. DEPT. WASHINGTON, KS.	SHOE SCRAPER	G.D.G. 12-28-67 SCALE 3/8" = 1"

APPENDIX D

SAWHORSE

PLATE TWO



VOC. AG. DEPT. WASHINGTON, KS.	SAWHORSE	G. D. G. 12-28-67 SCALE 1" = 12"

APPENDIX E

ARC WELDING AND FARM CARPENTRY TESTS

AGRICULTURAL MECHANICS TEST

ARC WELDING

Name: ____________________

Section A

True or False--Read each statement carefully before answering them: true (+) or false (0)

_+_ 1. A.W.S. is the abbreviation for American Welding Society.

_+_ 2. Undercut is a groove made in the base metal along the bead edges by heat of the arc and is left unfilled by deposit metal.

_0_ 3. A large diameter electrode cannot conduct high current without becoming excessively hot.

_0_ 4. Holding the arc too short will cause excessive spattering.

_+_ 5. If a bead is about twice the width of the electrode diameter, the speed of travel is correct.

_0_ 6. A.C. refers to active current.

_+_ 7. When a D.C. welder is on reverse polarity, the electrode is negative.

_+_ 8. The two common methods of striking an arc are tapping and scratching.

_+_ 9. The coating on an electrode burns slower than the metal core of the electrode.

_+_ 10. Distortion is a term used meaning the expansion and contraction of metal.

_0_ 11. The purpose of the coating is to protect the electrode while storing.

_+_ 12. Welding at too slow of speed will result in a wide bead.

_0_ 13. An E7018 electrode has a tensile strength of 7000 lbs. per square inch.

_+_ 14. Slag must be chipped from a bead before another pass may be made to prevent the formation of air pockets or slag inclusions.

_+_ 15. Tack welding is a method of controlling distortion.

Section B

Multiple Choice--All answers may be correct but only one is most correct. Place the letter corresponding to the most correct answer in the blank at the left of the question number.

_C_ 1. Fusion as a welding term means: A. to cover over. B. amperage setting. C. to join by melting. D. all of the previous.

_D_ 2. When an arc welder is set at the proper amperage the arc will make: A. steady humming noise. B. low sputtering noise. C. loud hissing noise. D. frying noise.

B 3. The diameter of an electrode refers to the: A. diameter of the core wire and coating. B. diameter of the core wire only. C. the length of electrode. D. none of the previous.

C 4. The correct included angle to make in preparation for a single vee or double vee butt weld is: A. 30° B. 45° C. 60° D. 90°.

D 5. Which type of joint preparation should be used for metal that is thicker than 3/8 inch? A. single vee butt B. double vee butt C. square butt D. any of the above.

D 6. When an electrode sticks to the work, one should: A. call the instructor B. remove it by twisting and pulling C. remove head shield and then twist it loose D. release the electrode from holder and remove with pliers.

C 7. Which type of joint preparation should be used for metal that is thinner than 1/4 inch? A. single vee butt B. double vee butt C. square butt D. any of the previous.

C 8. Welding with amperage setting too high will result in: A. rod sticking B. excessive build-up C. excessive splattering D. shallow penetration.

A 9. Penetration is necessary to: A. make the weld strong B. to improve the appearance of the weld C. make a smooth weld D. None of these.

_A_ 10. Poor penetration is caused by: A. wrong heat setting B. metal too thick C. too slow speed of travel D. too small electrode.

FARM CARPENTRY

Name: ________________

Section A

True or False--Read each statement carefully before answering them: true (+) of false (0)

_+_ 1. Kinds and grades of lumber differ in such properties as strength, stiffness, hardness, toughness and ease of working.

_0_ 2. Technically lumber is classified into two general classes--sapwood and heartwood.

_+_ 3. Softwoods are used more often on the farm than are hardwoods.

_+_ 4. Softwood is classified into various grades on the basis of the size, kind and number of defects present.

_0_ 5. Accurate measuring and marking is not as important as proper sawing of lumber.

_0_ 6. The most common measuring tool used and the least accurate is the carpenter's framing square.

_+_ 7. A marking guage is used to mark a line of equal distance from the edge of a board.

_0_ 8. The blade of a carpenter's framing square is 29" long.

_+_ 9. The amount of lumber which is removed by the saw is called saw kerf.

_0_ 10. A sharp tool is more of a danger than a dull tool.

_+_ 11. The cross-cut saw is used to cut across the grain of the wood.

_0_ 12. When sawing you should use short strokes with considerable pressure applied.

_+_ 13. The most frequently used lumber on the farm is common lumber.

_+_ 14. The most often used nails in farm carpentry are the common nails.

_0_ 15. A board 2" X 6" X 6" has 2 board feet of lumber.

Section B

Multiple Choice--Place the letter corresponding to the most correct answer in the blank at the left of the question number.

_B_ 1. The highest grade of hardwood lumber is called:
A. No. 1 common B. firsts C. selects D. No. 3B common.

_C_ 2. The tool which is used for laying out angles is:
A. the combination square B. the spring joint rule C. the carpenter's framing square D. the steel tape.

_B_ 3. The correct way to saw a board to length is to:
A. saw on the line B. saw on the waste side of the line C. saw on the side of the line which is on the section to be kept D. it doesn't make any

difference which side of the line you saw on.

D 4. The correct angle between the saw and the work for crosscut sawing is: A. 60° B. 30° C. 15° D. 45°.

A 5. The correct angle between the saw and the work for rip sawing is: A. 60° B. 30° C. 15° D. 45°.

A 6. When sawing curves you should use: A. a compass saw B. a back hand saw C. a crosscut saw D. a rip saw.

D 7. The purpose of a plane is to: A. square the edge of a board to an adjoining surface B. to smooth the surface of a board C. neither A or B D. both A and B.

C 8. The type of plane most commonly used to plane across the grain is the: A. smooth plane B. jack plane C. block plane D. rabbit plane.

A 9. The most common fastening devices used on the farm are: A. machine bolts B. finish nail C. lag screws D. wood screws.

B 10. When driving nails, the proper tool to use is the: A. shingle hatchet B. claw hammer C. ball peen hammer D. rivet hammer.

ARC WELDING SKILL TEST

Name: ________________

Perform the skills indicated below. Use your time wisely. Read and follow all the directions carefully.

Perform the following skills:

1. Secure 8 - 4" pieces of 3/16" flats
2. Secure welding equipment needed
3. Set up welder
4. Select electrodes
5. Select amperage needed
6. Strike and hole an arc 10 times on one piece of flat
7. Run a stringer bead the length of one piece of flat
8. Make a butt, lap and "tee" weld, welding the length of the metal
9. Clean all welds, mark with initials and hand in with test sheet
10. Clean up equipment and secure it

Skills	Score
Setting up welder	__________
Selecting electrodes	__________
Selecting amperage	__________
Striking an arc	__________
Stringer bead	__________
Butt weld	__________
Lap weld	__________
"Tee" weld	__________

FARM CARPENTRY SKILL TEST

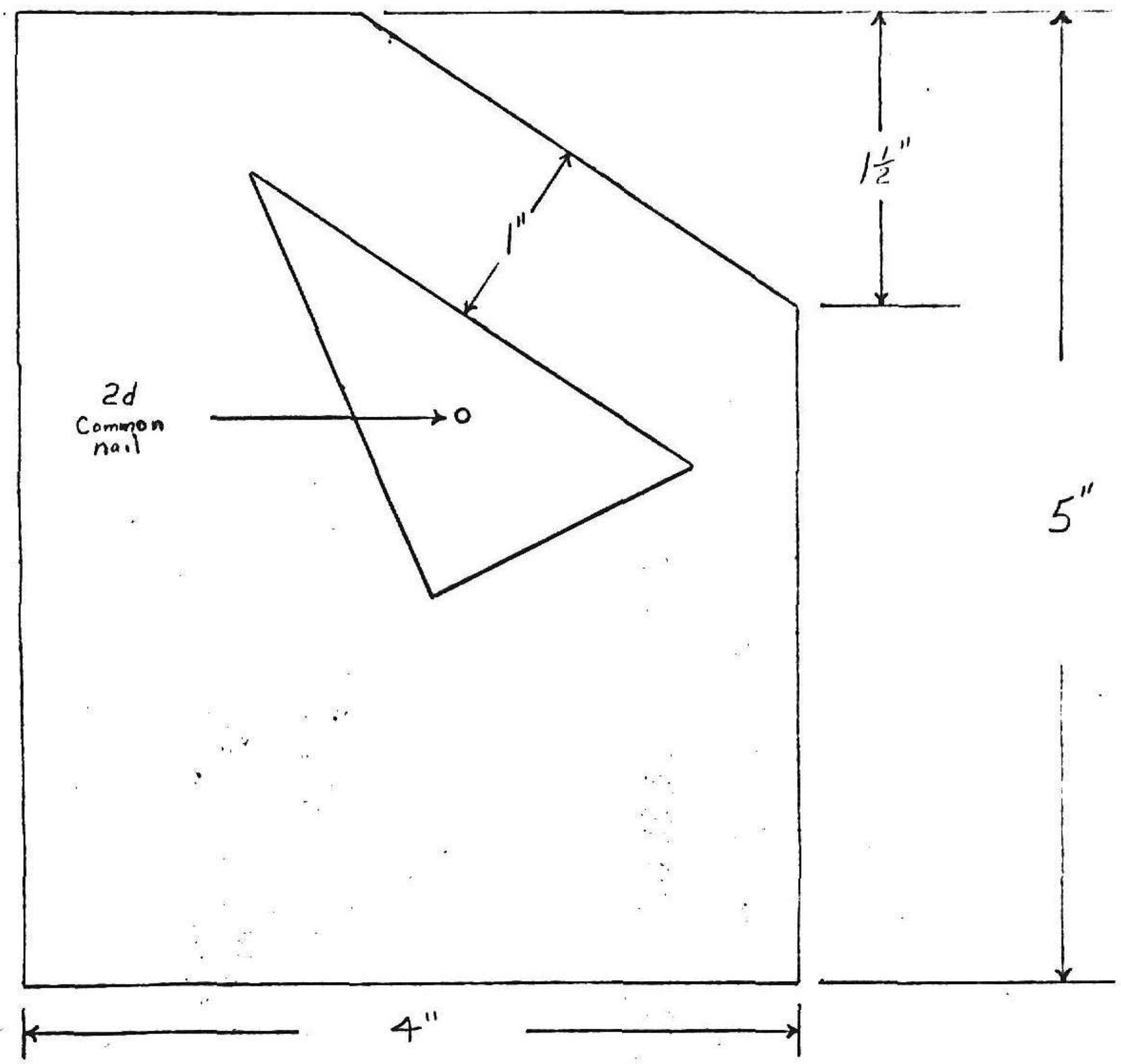
Name: ________________

Perform the skills indicated below. Use your time wisely. Read and follow all the directions carefully.

Perform the following skills:

1. Secure a 1 X 6" X 6" board from instructor.
2. Cut the board 5" long squaring both ends.
3. Rip the board to a width of 4".
4. Lay out and cut an angle from the end of the board equal to a 1/3 pitch. Make the angle 1 1/2" from the end on the right side of the board. (See drawing)
5. Using the 1 1/2" angle section glue it 1" from the angled edge of the 1 X 4" X 5" board.
6. Drive one nail in the center of the glued piece.
7. Clean up work bench and secure tools.
8. Mard skill with initials and hand it in with the test sheet.

FARM CARPENTRY SKILL BLOCK



Skill	Score
Tool selection	________
Measuring and marking lumber	________
Sawing lumber square	________
Sawing lumber at an angle	________
Gluing lumber	________
Nailing lumber	________

APPENDIX F

RESUME OF THE INDUSTRIAL ARTS INSTRUCTOR

RESUME OF INDUSTRIAL ARTS INSTRUCTOR

Name: Steven M. Murphy

Degree: Bachelor of Science

Granted from: Kansas State University

Date: 1968

Major Field: Industrial Arts Education

Minor Field: Drivers Education

Total Hours: 129 semester hours

Years Experience: 1 1/2 years

Present Employment: Instructor, Architecture and Design,
Kansas State University.

THE DEVELOPMENT OF BASIC AGRICULTURAL MECHANICS SKILLS BY BUILDING A SMALL PROJECT

by

GARY DEAN GISH

B.S., University of Wyoming, 1964

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1969

The purpose of this study was to compare the small project method and the drill method of instruction for agricultural mechanics skill development. The primary objective was to determine the difference in the improvement of skill development by implementing two methods of instruction, the project method and the drill method.

The students in the 1967-68 Vocational Agriculture One class, Washington High School, were used in the study. The students were given an opportunity to select one of two small projects (one in arc welding or one in farm carpentry). The selection of the project placed them into one of two groups, the arc welding project, carpentry drill group, or the arc welding drill, carpentry project group.

The same lesson plans were taught to each group. The groups were allowed fifteen hours in which to become proficient in the performance of the selected arc welding and carpentry skills.

The students in each group were given a pencil and paper and performance pre-tests and post-tests in arc welding and farm carpentry. The data gathered from the pre-tests and post-tests were used in determining the amount of improvement for each group.

Three criterion factors were used to determine the equality of the two groups. The criterion factors were: (1) Intelligence Quotient, (2) The students' grade point average at the end of the first semester of the 1967-68 school year, and (3) The students' scores on the written pre-test on arc welding and farm carpentry. After reviewing the data for the three criterion factors the writer assumed that the differences between the two groups were insufficient to hinder the results of the study.

The results from the pre-tests and post-tests indicated no relationship between Intelligence Quotients, and mechanical ability. The individual who had the lowest Intelligence Quotient scored equal to or higher than did the individual who had the highest Intelligence Quotient.

The data found showed that neither the arc welding project, carpentry drill group nor the arc welding drill, carpentry project group excelled in all of the skills tested. The results of the pre-tests and post-tests showed that the arc welding project group had greater improvement in two skills tested; selecting amperage, and running a stringer bead. The arc welding drill group exceeded the arc welding project group in two skills; making a butt weld, and making a lap weld. The two groups made equal improvement on the other arc welding skills.

The data showed that the carpentry drill group exceeded the carpentry project group in two skills; sawing lumber square, and sawing lumber at an angle. The project group exceeded the drill group on tool selection, and measuring and marking lumber. The remaining two skills, gluing and nailing lumber, were accomplished equally well by the two groups.

The hypothesis of the study that the improvement of the project group would exceed the improvement of the drill group was not supported by the 1967-68 Vocational Agriculture One class in the Washington High School.

After reviewing the data gathered from the study the writer concluded, that either the small project method or the drill method of instruction for agricultural mechanics skill development was an acceptable method for the 1967-68 Vocational Agriculture One class in the Washington High School since there were no differences in the improvement of the performance of the members of the two groups.