1977

The Development and Evaluation of Instructional Material in Farm Power Machinery.

Seburn Bluite Langham
Louisiana State University and Agricultural & Mechanical College

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IN FARM POWER MACHINERY

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Vocational Agricultural Education

by

Seburn Bluite Langham
B.S., Sam Houston State University, 1969
M.Ed., Sam Houston State University, 1973
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>ACKNOWLEDGMENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>vii</td>
</tr>
<tr>
<td><strong>CHAPTER</strong></td>
<td></td>
</tr>
<tr>
<td><strong>I. INTRODUCTION</strong></td>
<td>1</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>4</td>
</tr>
<tr>
<td>Research Methodology</td>
<td>6</td>
</tr>
<tr>
<td>Definitions</td>
<td>9</td>
</tr>
<tr>
<td><strong>II. REVIEW OF SELECTED LITERATURE</strong></td>
<td>11</td>
</tr>
<tr>
<td>Introduction</td>
<td>11</td>
</tr>
<tr>
<td>Early Farm Power Instruction</td>
<td>11</td>
</tr>
<tr>
<td>Economics of Agricultural Mechanization</td>
<td>18</td>
</tr>
<tr>
<td>Need for Instruction</td>
<td>21</td>
</tr>
<tr>
<td>The Future of Farm Machinery</td>
<td>27</td>
</tr>
<tr>
<td>Development of Instructional Materials</td>
<td>30</td>
</tr>
<tr>
<td>Evaluation of Instructional Material</td>
<td>36</td>
</tr>
<tr>
<td><strong>III. PRESENTATION AND INTERPRETATION OF DATA</strong></td>
<td>41</td>
</tr>
<tr>
<td>Instructors' Teaching Experience</td>
<td>42</td>
</tr>
<tr>
<td>Instructors' Educational Attainment</td>
<td>43</td>
</tr>
<tr>
<td>Adequacy of Instructor Farm Power Training</td>
<td>47</td>
</tr>
<tr>
<td>Types of Farm Power Instructional Programs</td>
<td>49</td>
</tr>
<tr>
<td>Reference Use in Farm Power Programs</td>
<td>50</td>
</tr>
<tr>
<td>Evaluation of Current Instructional Material</td>
<td>52</td>
</tr>
<tr>
<td><strong>IV. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS</strong></td>
<td>80</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>80</td>
</tr>
<tr>
<td>Methodology</td>
<td>81</td>
</tr>
<tr>
<td>Summary and Findings</td>
<td>81</td>
</tr>
<tr>
<td>Conclusions</td>
<td>88</td>
</tr>
<tr>
<td>Recommendations</td>
<td></td>
</tr>
<tr>
<td><strong>BIBLIOGRAPHY</strong></td>
<td>98</td>
</tr>
</tbody>
</table>
**APPENDICES** ................................................................. 105

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Developed Instructional Material</td>
<td>106</td>
</tr>
<tr>
<td>B</td>
<td>Letter to the State Directors of Vocational Agriculture</td>
<td>143</td>
</tr>
<tr>
<td>C</td>
<td>Letter to Secondary Farm Power Instructors</td>
<td>145</td>
</tr>
<tr>
<td>D</td>
<td>Questionnaire to Evaluate Current Instructional Material</td>
<td>147</td>
</tr>
<tr>
<td>E</td>
<td>Questionnaire to Evaluate The Developed Instructional Material</td>
<td>151</td>
</tr>
<tr>
<td>F</td>
<td>Instructional Pre- and Post-Test</td>
<td>156</td>
</tr>
<tr>
<td>G</td>
<td>Descriptors Used in the ERIC Literature Search</td>
<td>163</td>
</tr>
<tr>
<td>H</td>
<td>Letter to the Task Inventory Exchange, Ohio State University</td>
<td>165</td>
</tr>
<tr>
<td>I</td>
<td>Instructor Suggestions for the Development of New Instructional Materials</td>
<td>167</td>
</tr>
</tbody>
</table>

**VITA** ................................................................. 171
LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INSTRUCTORS' TEACHING EXPERIENCE</td>
<td>43</td>
</tr>
<tr>
<td>II. INSTRUCTORS' EDUCATIONAL ATTAINMENT</td>
<td>44</td>
</tr>
<tr>
<td>III. TEACHER EXPERIENCE AND TRAINING IN FARM POWER OR RELATED FIELDS</td>
<td>45</td>
</tr>
<tr>
<td>IV. ADEQUACY OF TRAINING AS PERCEIVED BY FARM POWER INSTRUCTORS</td>
<td>48</td>
</tr>
<tr>
<td>V. TYPES OF FARM POWER PROGRAMS CONDUCTED</td>
<td>50</td>
</tr>
<tr>
<td>VI. EXTENT OF REFERENCE USAGE IN FARM POWER INSTRUCTIONAL PROGRAMS</td>
<td>51</td>
</tr>
<tr>
<td>VII. EVALUATION OF CURRENT INSTRUCTIONAL MATERIAL</td>
<td>54</td>
</tr>
<tr>
<td>VIII. OVERALL RATING OF DEVELOPED MATERIAL</td>
<td>57</td>
</tr>
<tr>
<td>IX. NEED FOR MATERIAL</td>
<td>58</td>
</tr>
<tr>
<td>X. PREFERENCE FOR PRESENTING MATERIAL</td>
<td>58</td>
</tr>
<tr>
<td>XI. PREFERENCE FOR MATERIAL BINDING</td>
<td>59</td>
</tr>
<tr>
<td>XII. INSTRUCTORS' PERCEPTION OF THE DEVELOPED INSTRUCTIONAL MATERIALS WEAK AND STRONG POINTS</td>
<td>61</td>
</tr>
<tr>
<td>XIII. DEVELOPED INSTRUCTIONAL MATERIAL COMPARED WITH OTHER MATERIAL SOURCES</td>
<td>62</td>
</tr>
<tr>
<td>XIV. EXTENT INSTRUCTORS FEEL DEVELOPED MATERIALS WILL MEET PROGRAM NEEDS</td>
<td>66</td>
</tr>
<tr>
<td>XV. NUMBER OF INSTRUCTIONAL MATERIAL COPIES INSTRUCTORS NEEDED</td>
<td>69</td>
</tr>
<tr>
<td>XVI. ESTIMATED MATERIAL COPIES REQUIRED FOR SAMPLE INSTRUCTIONAL PROGRAMS</td>
<td>69</td>
</tr>
<tr>
<td>XVII. DESIRE FOR ADDITIONAL DEVELOPED MATERIAL</td>
<td>70</td>
</tr>
<tr>
<td>XVIII. MOST EFFECTIVE USE OF INSTRUCTIONAL MATERIAL</td>
<td>71</td>
</tr>
<tr>
<td>TABLE</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>XIX.</td>
<td>FARM POWER AREAS IN WHICH INSTRUCTORS DESIRED NEW INSTRUCTIONAL MATERIAL TO BE DEVELOPED</td>
</tr>
<tr>
<td>XX.</td>
<td>ANALYSIS OF STUDENT GROUP BY GRADE</td>
</tr>
<tr>
<td>XXI.</td>
<td>ANALYSIS OF STUDENT GROUP BY AGE</td>
</tr>
<tr>
<td>XXII.</td>
<td>DIFFERENCES BETWEEN MEAN CORRECT RESPONSES ON PRE-TEST AND POST-TEST BY AREAS OF SUBJECT MATTER</td>
</tr>
</tbody>
</table>
ABSTRACT

Purpose

This research was designed to develop and evaluate instructional material for use by high school vocational teachers in the area of farm power and machinery.

The following objectives were formulated and used as guidelines to aid in solution of the problems:

1. Determine the status of farm power instructional material currently used at the secondary school level.
2. Determine the educational and experience status of instructors currently teaching secondary farm power.
3. Develop instructional materials on tune-up procedures of gasoline farm power units for use by secondary school students.
4. Evaluate the developed subject matter material using a jury of teachers now teaching in the field of farm power and machinery.
5. Evaluate the developed subject matter material using classroom instruction with secondary school students.
6. Formulate recommendations for the development and use of future farm power instructional materials produced in this style.
Procedure

Three areas were selected to develop instructional material for testing. These are spark-plug replacement, engine timing, and distributor service. A list of steps and skills needed to perform these tasks was constructed. The steps and skills were then reviewed by a jury composed of persons familiar with the farm power field.

Photographs were taken of each step in the reviewed skill list. The photographs were photocopied and the major points traced for reproduction. The proper script was added to the drawing and the material reproduced.

The study was divided into three phases:

Phase I--Fifty secondary farm power teachers were asked to evaluate current instructional materials presently used in their programs and to give recommendations for improvement of new materials being developed.

Phase II--The same fifty teachers reviewed the developed materials and evaluated them for use in their programs. They compared them also to the instructional materials they were presently using.

Phase III--This phase was based upon teaching research using the "one group pre-test to post-test research method." In this process the dependent variable (student knowledge) was measured before the independent variable (instructional materials) was applied, after which the amount of change was computed.

Findings

Instructors of farm power prefer to use instructional materials having practical value. This was shown by the preference for materials
used in industry and materials the instructors developed. It appears that other developers of instructional material have not met the needs for instruction in farm power on the secondary school level. This is especially true of textbooks, which have been the traditional source of reference for such instruction.

Farm power instructors as a whole are well experienced and qualified in their field. The traditional methods of training such as college coursework was used in gaining knowledge. Data show many instructors found employment previously in trades and industrial jobs. Other sources such as military and vocational trade school training offered the instructors invaluable hands-on experience.

Instructional materials developed and prepared by the writer for this research were accepted favorably by secondary instructors of farm power. It was concluded that instructional material of this style would aid the teacher and students.

An overwhelming majority of instructors felt there was a need for material developed in this style. The results of the study indicated the developed material was superior or far superior to all listed instructional sources except personally developed materials.

Within the limits of this study, it can be stated that when the developed instructional materials were used in the shop, student proficiency in the area of farm tractor tune-up was enhanced.
CHAPTER I

INTRODUCTION

History gives credit to Gottlieb Daimler for inventing the internal combustion engine in 1885 and to Benjamin Holt for using it to power the first tractor in 1900. (12:440) Neither of these men could possibly know the impact they would have in shaping the future of agriculture and the rest of the modern world. The progress made since the early engines that used such crude fuels as gunpowder and coal to the turbo-charged diesel engines found in the modern farm tractor has been a remarkable feat within a time span of only 91 years.

The farmer of today has a choice of 155 models of tractors that range in size from 20 horsepower to 450, with the largest number coming in the 100 plus horsepower range. (36:19) These tractors are no longer the stripdown models with bare necessities, but come equipped with every convenience that is available on luxury automobiles. With the addition of cabs, made necessary by Occupational Safety and Health Administration safety regulations, came the comfort items of heating and air conditioning systems. Even such accessories as radios, tape-decks, and mobile-telephones are found in increasing numbers as equipment on the modern farm tractor.

The improvement in cosmetic and convenience items can in no way equal the improvement made in performance and mechanical efficiency of tractor power for the farm. As the horsepower requirements to the drawbar increased, in like proportion the strain and stress on the
drive-train also increased. In addition to wanting more powerful equipment the farmer demanded other engineering changes. Equipment operators no longer wanted to come to a complete stop to change gears or drive ratios. Also because of the higher increase in production cost, farmers no longer wanted to be at the mercy of the ever changing weather. Machines were desired that could work in field conditions that were less than optimum regardless of the weather conditions.

These desires were translated to implement manufacturers and design engineers. The result of the manufacturers' desire to meet the needs of the farmer and ultimately secure his patronage brought about notable changes in the mechanical functioning of tractors. Automatic transmissions replaced the manual clutch, thus allowing the operator to vary the gear ratio while the unit is in operation. This improvement means that the equipment can be maneuvered over different grades and soil conditions without coming to a time-consuming stop. The improvement and increased use of hydraulics allows the operator to make adjustments to the implements from the cab, thus making maximum efficiency possible. With the use of four-wheel drive has come the advantage of increased traction. Units now operate in field situations that were impossible in the past due to the weather and soil conditions.

Technology advancements have brought about remarkable improvements in equipment that is available to farmers, however, at the same time a multiplicity of problems has resulted. As agriculture becomes more dependent upon mechanization, time lost to repairs or adjustments has become increasingly important. Agricultural producers have made great use of modern agricultural machines, but rarely do they understand their complex functioning. A modern farm tractor embraces all
theories of engineering and consists of thousands of parts. It must operate in temperatures of below freezing to well above 100°F. over uneven terrain and in mud, dust, and snow.

The individuals responsible for service and repair of these units are called upon to acquire and possess an ever increasing amount of knowledge. To meet the needs of agriculture, students must be trained to diagnose troubles, make repairs, and understand the function and operation of the unit. This training must be a continuous developmental process that has one broad goal, the development of individuals whose talents and abilities have materialized so that they may find satisfaction in a vocation of agricultural mechanics. To accomplish this goal the school should require the instruction and training of students in the skills of workmanship as well as the theory and concepts needed for the vocation. The program should include both current and past information and be adaptable to changing situations. It should provide for the needs of the students and industries as determined by the changing trends, conditions of world affairs, and by the probable future needs of society and agriculture.

To help the schools reach these goals instructional materials should be developed and evaluated for use in the classroom. These materials should be up-to-date or timely, easy to read and understand, and be adaptable to local conditions. Examination of most agricultural mechanization libraries reveals that the majority of literature is outdated and of doubtful usefulness. To understand some, the dictionary or other reference volumes must be consulted, a venture most students will not undertake.
Prepared instructional materials are an integral part in the teaching of agricultural mechanics as well as other educational areas. These materials are important to the teachers who need reliable information structured for teaching purposes. When materials of instruction are adequate both in quantity and quality, the teaching-learning situation has the potential to reach its maximum effect.

Statement of the Problem

This research was conducted to develop and evaluate instructional material for use by high school vocational teachers in the area of farm power and machinery.

Operations today in agriculture are very complex and sophisticated. Farmers and others involved in supportive work in agriculture face ever increasing problems that are highly technical in nature.

No area in farming has shown more need for technical training than farm power and machinery. In 1975 American farmers purchased 5,128,000 new tractors, 2,882,000 new trucks, and millions of other farm power units. Repair of these units and others already on the farm cost agriculture producers $6,462,000,000 annually. (67:108) Today it is not the issue of cost alone but the availability of labor to make these repairs. A farmer often must delay operations due to repairs that he or his employee could be trained to accomplish. Most of these are simple maintenance jobs that can be learned by instruction in an orderly sequence.

The concern of this study was the development and evaluation of instructional materials that would be of value to the vocational agriculture teacher in the teaching of tune-up procedures on gasoline farm power units.
Many sources of instructional material are now available to instructors, but none are obtainable in elementary levels for use by first contact students. As the population shifted from rural to urban it brought to the vocational agriculture classroom a new type of student. Although these students desire to work in agriculture, many have never been exposed to the simple facts and duties that are common to youth reared in a rural background.

To assist the instructor in this timely problem, developers of new instructional material must keep this constantly in mind. More specifically the following objectives were formulated and used as guidelines to aid in the solutions of the problem:

1. Determine the status of farm power instructional material currently used at the secondary school level.
2. Determine the educational and experience status of instructors currently teaching secondary farm power.
3. Develop instructional materials on tune-up procedures of gasoline farm power units for use by secondary school students.
4. Evaluate the developed subject matter materials using a jury of teachers now teaching in the field of farm power and machinery.
5. Evaluate the developed subject matter material using classroom instruction with secondary school students.
6. Formulate recommendations for the development and use of future farm power instructional materials produced in this style.
Research Methodology

Three areas were selected to develop instructional material for testing, spark plug replacement, engine timing, and distributor service. A review of related literature as well as the author's personal experience were used to construct a preliminary list of steps and skills needed to perform these tasks. The steps and skills were then reviewed by a jury composed of persons familiar with the farm power field. This jury consisted of university instructors in agricultural engineering, Louisiana State University; agricultural education, Louisiana State University; a high school teacher of farm power, Westwood, Texas; and a representative of the tractor industry, Palestine, Texas. The members of this jury were contacted personally and worked individually.

It is commonly agreed that instructional material using a large amount of pictures and instructional material presented in a step-by-step sequence are both effective in increasing student knowledge. To combine both styles was the aim of the writer in producing new instructional material. The new materials were presented in the normal sequence in which the task is performed and supplemented with a picture for each step.

This style of material presentation should give the student proper order and technique to perform the task as well as confidence supplied by the picture. The adage of Confucius "one picture is worth a thousand words" was relied upon heavily in preparing the instructional material.

Photographs were taken of each step in the reviewed skill list. Due to the cost of reproducing photographs in a publication it was decided to use drawings. The photographs were photocopies and the major
points traced for reproduction. Necessary drawings were reduced or expanded to allow for uniform drawing size.

A validating jury, consisting of the same individuals used to develop the skills list, reviewed the drawings and script and made suggestions for improvements. In addition, suggestions were taken from returned questionnaires regarding improvements in instructional material desired by secondary farm power instructors. Necessary final revisions and improvements were then incorporated in the final printing of the instructional material. (Appendix A)

A letter (Appendix B) requesting a list of vocational agriculture teachers now teaching farm power agriculture laboratory training programs was forwarded to the fifty state directors of vocational agriculture education. A letter (Appendix C) explaining the purpose of the study and a request for support from the teachers was mailed to help select the sample instructors. From the returned responses fifty teachers were selected personally by the author as participants in the study. No formal randomization was used in the selection of instructors due to the form in which state directors forwarded teacher lists.

The study was divided into three phases:

Phase I--The fifty teachers were asked to evaluate current instructional materials presently used in their program and to give recommendations for improvements they felt should be made in new materials being developed. (Appendix D)

The participants were also asked to give information about their individual status and preparation for teaching farm power. This information yielded a profile of the teacher's background and educational
experience as well as the general status of farm power now taught at the secondary school level.

Phase II--The same fifty teachers reviewed the developed materials and evaluated them for use in their programs. They also compared them to the instructional materials they were presently using. Recommendations for improvements and new areas in which materials should be developed were also offered by the instructors. (Appendix E)

Both Phase I and II were conducted by use of a questionnaire. The instrument was designed to obtain the maximum amount of pertinent information from the respondents with a minimal amount of their time and effort. The questionnaires included checklist, forced responses and open-end questions. The checklist and forced responses allowed for ease of answering and compiling the returned data. The open-end questions allowed the respondents to express their views.

Phase III of the study was based on teaching research using the "one group pre-test to post-test" research method. (26:230) In this process, the dependent variable (student knowledge) was measured before the independent variable (instructional materials) was applied. The post-test was administered and the amount of change computed.

Two schools having instructional programs in farm power were selected to participate in the study, Elkhart High School, Elkhart, Texas, having 13 students and Westwood High School, Palestine, Texas, having 9 students.

The students were given a pre-test which consisted of selected multiple choice questions. A skill test was also given to ascertain the
amount of hands-on experience the students possessed. After the instructional material was covered by the instructors a post-test and skill test was administered. (Appendix F)

The test questions and pages were not numbered in the pre-test and post-test and the order of collating the sheets varied, thus providing a more equal opportunity for retaining the discriminatory power of each question.

The principal concern during Phase III was to determine whether there was significant change in student understanding and skill from pre- to post-test results.

The processed data were then organized in tabular form for presentation and interpretation. The statistical techniques used were frequency, percentage distributions, weighted mean score and analysis of variance.

Definitions

The following terms were used in the study as defined:

Farm Power Instruction -- Instruction in the selection, adjustment, operation, maintenance, and repair of farm machinery and equipment.

Agricultural Mechanization -- A technical area of study below the professional level of agricultural engineering. It involves the mechanical activities performed on the farm with tools and equipment accessible to the farmer.

Cooperative Training Program -- A training program which correlates actual work experience in a subject with classroom instruction under the coordination and supervision of an instructor who is occupationally competent.
Agricultural Laboratory Training -- A training program which teaches actual work experience in the classroom and laboratory under the supervision of an instructor who is occupationally competent.

Adult Education -- Training designed to meet the needs of out-of-school individuals. This instruction is usually designed to advance the individuals in their present occupation or to train them for a new vocation.
CHAPTER II

REVIEW OF SELECTED LITERATURE

Introduction

A comprehensive survey of publications and literature revealed extensive research and numerous articles on the various aspects of Farm Power and Instructional Materials. This search for literature involved books, magazines, dissertations, and summaries of studies.

To accomplish the review of literature the following research was conducted to determine the resource materials available:

1. An ERIC search was run through the Louisiana State University library using the descriptors listed in Appendix G.
2. A hand search was conducted of the AIM/ARM abstracts in search of relevant materials.
3. A hand search was conducted of the Dissertation Abstracts International for any related material.
4. The Task Inventory Exchange, Columbus, Ohio, was written in the search of any pertinent material. Appendix H.

Materials deemed pertinent to this study were selected for review.

Early Farm Power Instruction

The American educational system which began over three hundred years ago has changed dramatically. Throughout the history of the
United States groups of different cultural, ethnic, and racial backgrounds have added their part to make this the most unique and successful system in the world. The American educational system was conceived and advanced by people using the best techniques and knowledge available. The success of the United States has resulted from developing educational plans and the resource by which to accomplish these plans.

The purpose of democracy is so to organize society that each member may develop his personality primarily through activities designed for the well-being of his fellow members and of society as a whole . . .

Education is a democracy, both within and without the school should develop in each individual the knowledge, interest, habits, and powers whereby he will find his place and use that place to shape both himself and society toward even nobler ends. (67:21)

These words written in 1918 adequately express the philosophy and purpose of vocational education. The agriculture mechanization phase of vocational agriculture has strived to meet these goals since the establishment of the program in the same year.

J. H. Gill (37:11) commented on the importance of farm machinery instruction in an article in The Vocational Summary in 1919.

We have learned many lessons by the recent war. May we not learn a lesson as to how this instruction can be gotten to those who need it?

The war was a war of machinery. It was realized that the machinery to be effective must be kept in repair, and that these repairs must be made as near where the machinery was used as possible. This resulted in the development of the mobile repair shop that followed the machinery into the field and made all the ordinary repairs as near as practical to the place where the machinery was being used. Is it not entirely feasible to utilize the mobile shop as a means of instructing farmers in care, repair, and operation of farm machinery? A traveling school in farm mechanics could do a vast amount of good. A truck fitted with a forge and a few good blacksmith's tools, a set of pipe tools, a bench, and a set of carpenter's tools, together with a small stock of material could be used to
take the equipment and instructor to the farm communities and give instruction to gatherings of farmers. The instructor should be a skilled mechanic who is familiar with farm machinery, the gasoline engine, automobile, tractor, and with general woodwork. The tractors used in demonstration will be available from the local farmers.

As the use of farm machinery increased in the early years a like need was observed for persons trained to maintain the equipment. Fletcher (35:5) discussed the competition between industry and agriculture for these individuals in the *Agricultural Education Magazine* in 1929.

Machine methods of production have not ruined our agriculture. We should rather credit farm machinery with reducing the expenditure of manual labor on our farms, with shortening the working day, with increasing the production per worker. Progress consists of continuously solving the problems of today which arise out of the solution of the problems of yesterday. To solve a problem is to create another.

Large farming is in the air. The question is not whether we want the large farm but rather, what are we going to do with it? How will we direct its development?

This is an age of specialization. Other industries employing the specialist have prospered. As now commonly organized agriculture cannot most effectively employ highly trained men. The average farm unit is too small to bear the cost. However, the large farm is unusually attractive to the trained man. Because of valuable experience gained during recent years, more large farms are succeeding. The tendency of all successful industry is to expand to increase the size of the project.

In a book entitled *Shop Management in Rural High Schools* by Louis M. Roehl (20:32) it was stated that to be a good mechanic you must have a complete set of tools and supplies. Mr. Roehl suggested the following list:

1 set of ratchet socket wrenches
1 set of 10 engineer's double-end wrenches
1 belt lacer and belt hooks
1 bundle of 1/4 in. cut lacing leather
1 tire gauge
1 automobile jack
1 tire pump
1 hydrometer for battery testing
1 box valve-grinding compound
1 valve lifter
1 valve grinder
1 thickness gauge
1 valve-refacing lathe
1 set of 3 bearing scrapers
1 set of 4 car-wheel pulls
2 spark-plug wrenches 1/2 and 7/8 in.
1 tappet-wrench set
1 trouble lamp
6 magneto files
1 set magneto wrenches
3 squirt oil cans
1 oil measure with funnel top
3 tin funnels, various sizes
4 boxes each, brass split rivets: 5/16, 3/8, 1/2, and 5/8 in.
6 long-handled wire brushes

It was estimated that the complete set of tools would cost the purchaser approximately thirty-five dollars. With these tools the mechanic should be able to make all the ordinary operating adjustments, and to do the repair jobs connected with gas engines.

Some early educators were against a strong shop program or one that taught advanced skills. Early textbooks cautioned the farmer to consider carefully before buying a tractor as noted in the Farm Mechanics Text and Handbook (8:411) published in 1946.

A tractor should be selected only after considering the advantages and disadvantages of the different types of farm motors that are suitable for the job. Original cost, adaptability, soil conditions, farming program, economy, and timeliness of operations are factors to consider in selecting a main power plant, such as tractors or horses. The ability of the operator to properly operate and care for a tractor are important in order to insure more complete satisfaction with a tractor for power.
Advantages of farm tractors—The advantages of farm tractors are:

1. Requires no fuel or attention when not in use.
2. Adapted to draft, belt, and power take-off work.
3. Has considerable range of working speeds.
4. Can work continuously at heavy loads.
5. Is not affected by hot weather.
6. Quickly available in case of emergency.
7. Requires small storage space.

Disadvantages of farm tractors—The disadvantages of tractors may be listed as follows:

1. Requires cash expenditures for fuel and lubricants.
2. Not flexible in size of working unit.
3. Operates efficiently only at rated loads in most cases.
4. Requires mechanical skill for successful operation, care, and adjustment.
5. Has a limited overload capacity.

Other early educators saw the need for instruction in power machinery and spoke out for the need. In an article entitled "Justification of Power Machinery in Vocational Shops" published in The Agricultural Education Magazine, April 1938, Mr. Clark offered his views on the subject:

Power machinery has been taboo in the vocational shop in the past, largely on account of the fact that the vocational shop was originally patterned from the old type manual projects with farm need in mind.

We are living in the greatest agricultural power machine area in the United States; and if we are going to give our boys the training in their problems we have to have a more extensive shop program.

Every teacher endeavors to make his shop interesting by relating it to life situations, to human interest, to natural impulses, and to acquire experiences and ideals. Shop work is a life situation. School should be life itself where the student can select his own problem.

Conditions are changing; if you make only a brief survey, it shows one very pronounced trend, the increased mechanization of life. This is not a new discovery—It
has been going on for years. Look at the production of oats in the United States, and since 1919 in direct proportion to the population of horses. This brings about a new kind of shop work in the understanding, use, and repair of power machinery.

Our shop work must continually be kept in a state so it will meet the needs of the farmer. Not all our students are going to make a success of farming, and some are not going to be able to establish themselves in farming. It will then be necessary for them to earn a living at some other vocation. The more things a boy can learn to do well, to which he may turn in time of need to make a living, is a part of any department's work in school. Fully realizing that we are teaching vocational agriculture, we must cover all fields in shop work—electricity, plumbing, blacksmith, auto, tractor, carpenter, and machinist.

What are the shop problems which give the farmer the most concern? It is not the making of a nail box, hog trough, chicken feeder, or putting a bottom in his wagon box. We grant we want to teach the skills in using hand tools. The electrification of farm homes with electric appliances, motors, and the power machinery coming on the farms in the form of autos, tractors, large machinery, is where we find the shop problems on the farm.

It is our job to teach the repair of farm machinery. What do we need to make these repairs? First, a forge and anvil, grinder, drill, valve refacer and lathe. Forges, anvils, drills and grinders are all picked up by farmers at a premium whenever they're sold at sales, because the boys who have had training are using them on their farms to make the repairs. Farmers are bringing in old materials from grinders, auto parts, gas engines, etc., to have grinders made in our shops to use on their farms, because they are finding a great need for them and have tractors for power to operate them.

Not every farmer will have all the equipment to do all his work, but the vocational shop is a place to which, if you will open the doors, he will come and work in overhauling his motors, auto, tractors, and farm machinery. The farmer learns to use this machinery and helps advertise your school and course to farmers, as he sees the benefit of the machinery and his boy's learning to do the job of keeping it in repair. Boys are making a lot of power tools for their farms in the farm shop. The forge, drill, grinder, and lathe make it possible to make hacksaw, frames, power saws, etc., in the vocational shop. I have boys who say they are going to have a lathe in their farm shop as
soon as they are established. It is surprising how many power tools in the form of lathes, grinders, band saws, jig saws, shapers, planers, and sanders are going into farm and city basements and shops. As soon as electricity comes on our farms the power machines will follow.

There are places in every community to do shop work for neighbors as a side line for vocational boys who are well trained in shop practices. I have a boy who graduated several years ago who has established a shop on his farm and reports a very good income in repair work of all kinds.

The lathes in our shop are busy most of the time with boys turning armatures for generators, starters, electric motors, bearings for motors, wind chargers to furnish electricity for their homes, and repair of equipment in shop, school, machinery, and parts for cars. It enables us to do the whole repair in many cases from waste materials or cheap materials, which otherwise would not be accomplished if boys had to pay for new materials and a dollar an hour for skilled labor to make the repairs. It gives the boys an interest in doing the work.

The lathe enables us to make a large number of tools for jobs we need in our shop in the use of shafts, pulleys, bearings, repairs on forges, drill press, chuck, etc. It was necessary this fall to put new handle grips on shafts; all this repair was done in our shop from scrap iron. All the electric motors have been cleaned and overhauled, with bearings which needed it because of our lathe equipment. Farmers who have or have had boys in school are bringing cars, trucks, and machines to overhaul during the winter months, which furnishes jobs, interest, variety, and a healthy shop program.

The machine age—with the increased problems brought on the farmers with the upkeep, repair, and maintenance of this machinery, together with the increased interest of shop work as well as training the boy in the use of machines and principles of repair, also the additional crafts which a boy may use in case of necessity—justifies the use of all the equipment which boys are apt to find useful in their life work.

A brief look at farm power's role in agriculture was given by Lanham (43:24) as he explained its importance and progress.

Development of the internal combustion engine in the 1800's provided a lighter and more compact power source. Those first tractors generally hitched to various implements in place of the familiar team. Early tractors and self-propelled cultivators might have gasoline, kerosine, or distillate engines.
In 1910 there were less than 1,000 tractors on U.S. farms. Five years later the count was 25,000. By 1919 it was 158,000. But the tractor age didn't truly begin until the 1920's when manufacturers introduced a host of specialized harvesting machines.

Probably no machine was more rapidly adopted by farmers than the horseless carriage. It wasn't just a better way to move people from here to there, it was a work vehicle adaptable to all sorts of hauling and pulling tasks. By 1914 there were 343,000 cars and 15,000 trucks on American farms, along with 17,000 tractors.

The next decades saw an amazing progression of new field equipment to handle a myriad of farm routines with a safety and convenience not even conceived of by those early visionaries.....

Economics of Agricultural Mechanization

The economic contribution of the internal combustion engine to the production of food in the world is tremendous. In early agriculture a farmer fed himself, his family, and perhaps had a small amount to sell or trade. In the United States in 1976 every farmer fed 50 people (11:24), allowing 49 persons to be employed in producing other goods. This reduction in the number of persons now in production agriculture is directly related to the increased use of machinery.

The enlarging use of machinery means a larger percentage of the farm budget must go for the purchase and repair of equipment used. The economic importance of agricultural mechanization in Minnesota was shown by Dr. A. K. Solstad (49:147) in a published article. Some of Dr. Solstad's findings were:

Mechanization expenses are reaching the 50% level of total farm costs over a recent 13 year period, the Minnesota Farm Management Service found in 2,613 sets of farm records that an average of 50.5% of the expenditures were in this area. Of this total, 17.8% was for farm power, 11.2% crop and general machinery, 2.8% livestock equipment, 8.6% buildings, fences, etc., 3.1% insurance and taxes (mechanization share). The 522 most profitable farms showed a total
of 46.7% expenses in mechanization while the least profitable farms showed a higher figure indicating that the more efficient farmer kept expenses down in this area while still taking care of more units per worker and keeping the mechanization expense per work unit lower than the less efficient operator.

Data shown above reveal the greater role and importance of machinery in agricultural production. This is illustrated by the fact that farm mechanization expenses amount to half of production cost. On the average U.S. farm, total assets represent about $46,000 per worker with $5,000 being in machinery. (45:22)

Dr. Donnell R. Hunt (13:14), professor of agricultural engineering at the University of Illinois, found that of 2,000 Illinois farms surveyed the average cost for operating machinery comprised nearly 36 per cent of the yearly farm cost. Dr. Hunt's findings show that machinery expenses will be continuous for the farming operation even if new units are not added.

Although the direct cost to the American farmers for repair of machinery is $6,462,000,000 (68:430) annually, the number of jobs created is certainly felt by the economy. Several states have conducted studies to determine the number of persons employed in agriculture service and to make predictions of future worker numbers.

Research conducted by C. L. Mondart Sr. and C. M. Curtis (62:18) at Louisiana State University, entitled Nonfarm Agricultural Employment in Louisiana with Implications for Developing Training Programs, reported that 1,828 jobs existed in the farm machinery sales and service in Louisiana. They also found that a 9.8 per cent increase in jobs will develop within a five year period from 1967. Of the eight occupational families surveyed, the greatest predicted increase for employees was
in farm machinery sales and service, where a 22.9 per cent increase was predicted.

Additional research was conducted by Dr. Earl S. Webb (87:2), professor of agricultural education at Texas A&M University. Dr. Webb found that Texas had an extreme shortage of persons trained in agricultural machinery service occupations. He listed farm machinery mechanics as the most needed, with the estimated number needed now and within the next five years exceeding 7,000. The second greatest need was for trained partsmen with the number now and within the next five years exceeding 3,600.

In a similar study conducted by Virginia Polytechnic Institute (57) 5,649 workers in 125 nonfarm agricultural businesses were surveyed to determine the types of training employees needed to be successful in their jobs. The study showed 13 per cent of the population needed training in related skills such as welding.

A New Mexico study conducted in 1966 by Cobb (32:16), made predictions of employment opportunities that would be available in three years. Questionnaires were sent to 153 selected machinery and implement dealers in New Mexico and west Texas to obtain their future employee needs.

The results, based on a 67 per cent questionnaire response, showed a future need of 381 employees. Need for mechanics was in first place with a total of 190. Other areas of need were machinery parts clerk 42, mechanics helper 31, and assemblyman 27.

All employers indicated in the survey that they would hire a graduate of a two year training program at a higher salary than they would a high school graduate without farm machinery training.
**Need for Instruction**

If the school systems are to prepare students to become employable young adults, instruction must be offered to accomplish this goal. Problems facing the agricultural mechanics teacher is what to teach, when to teach it, and how advanced it should be.

It is obvious that a teacher cannot teach what he does not know. Agriculture teachers must be trained in agricultural mechanization to plan and conduct a successful program that gives maximum benefit to the student.

West and Lawrence (52:137) conducted research to determine the need for in-service training in agricultural mechanics in West Virginia. Some of the findings are:

Agricultural instruction, to be of maximum benefit to students, must be taught by instructors who are well trained and who remain abreast of new developments. To determine needs and desires of vocational agriculture teachers for in-service training in agricultural mechanics areas, a study was recently conducted in West Virginia. An integral part of the study dealt with teacher's preferences regarding length, time, and location of summer in-service workshops designed to meet expressed needs. Information was obtained through questionnaires mailed to the 100 vocational agriculture teachers of the State. Data from 82 usable returned questionnaires were analyzed.

Teachers were asked to indicate their need for additional training in 42 skills listed under the eight major categories of agricultural mechanics work. Skills in which training needs were considered greatest were primarily in agricultural power and electrification.

Recipients of the questionnaire were requested to rank the eight agricultural mechanics areas as to priority preferences, i.e., which area should be offered first, second, third, etc., in in-service workshops. A summary of these data is presented in Table 1.
Table 1

Ranking of Agricultural Mechanics Areas by In-service Training Priorities

<table>
<thead>
<tr>
<th>Rank</th>
<th>Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agricultural Machinery</td>
<td>76.8</td>
</tr>
<tr>
<td>2</td>
<td>Agricultural Power</td>
<td>64.7</td>
</tr>
<tr>
<td>3</td>
<td>Shop Skills</td>
<td>58.6</td>
</tr>
<tr>
<td>4</td>
<td>Structures and Environment</td>
<td>47.7</td>
</tr>
<tr>
<td>5</td>
<td>Electrification</td>
<td>47.5</td>
</tr>
<tr>
<td>6</td>
<td>Agricultural Mechanics Methods</td>
<td>44.9</td>
</tr>
<tr>
<td>7</td>
<td>Soil and Water Management</td>
<td>41.5</td>
</tr>
<tr>
<td>8</td>
<td>Processing, Handling, and Storage</td>
<td>13.4</td>
</tr>
</tbody>
</table>

Only binary percentages are included in the summary indicating total percentages of teachers expressing priority for training in the top four categories within each major area. Although need for additional skill training in agricultural machinery was perceived as somewhat less than for power and electrification, teachers gave top priority to in-service workshops in the area of machinery.

Nearly half the teachers responding indicated a definite desire to attend in-service workshops designed to upgrade skills in agricultural mechanics. Another 47 per cent would attend if circumstances allowed. Only three teachers, all near retirement, said they would not participate.

Sixty-five per cent of the respondents expressed a preference for workshops to be held at local high schools within their own vocational agriculture districts. The remainder preferred workshops on one of the two college campuses. Nearly 64 per cent attached importance to the offering of college credit for workshop attendance.

A distinct majority of teachers preferred that workshops be held during the month of July. August was the second choice. Workshops a week in duration appeared to be the most suitable, with few expressing interest in longer periods of training.

Statistical analysis indicated little relationships between expressed needs and pre-service courses taken, previous in-service work, or teaching experience. The analysis did, however, indicate a significant lessening of perceived needs in agricultural power skills and welding when teachers had taken the courses "Agricultural Engines" and "Welding and Heat Transfer" as undergraduates.
The following recommendations were made, based on analysis of data obtained, as a means of improving the vocational agriculture teacher's skill in agricultural mechanics:

1. Students enrolled in agricultural education should take the courses "Agricultural Engines" and "Welding and Heat Transfer" plus an additional nine hours in agricultural mechanics training.

2. One week in-service workshops in agricultural mechanics should be held in local vocational agriculture district high schools during the month of July. College credit should be offered for participation.

3. Workshops should be planned to develop skills in priority areas of greatest perceived needs.

4. In-service training should be practical in nature, and teaching materials used in workshops should be made available for teachers' use in local programs.

Instruction in farm power machinery is very important to the farmer himself. In a study by Norman D. Skadburg (47:112), agricultural instructor, Williamsburg, Iowa, the importance of certain mechanical skills were ranked. As noted in Mr. Skadburg's findings, knowledge in the area of farm power was the highest ranking in importance. Some of his findings were as follows:

Agricultural mechanics skills should aid the boy when he enters farming. By conducting a survey of farmers I felt I could find how valuable the farmers felt certain skills or abilities were in their farm operation.

I felt I could revamp my agricultural mechanics program when I tabulated the results of my survey. Some skills or abilities should be added to the program, other skills eliminated, and the time spent on others either lengthened or shortened.

A survey form consisting of agricultural mechanics skills in the areas of carpentry, welding and metals, concrete, gasoline engines, electricity and electric motors, and tractor and machinery power and management were mailed to farmers in the school district. The farmers were asked to indicate how valuable the 64 agricultural mechanics skills or abilities on the survey were in their farming operation. The classifications from which they could choose were as follows:
All of the 64 skills in the survey could be taught in our agricultural mechanics laboratory in the Williamsburg Community Schools.

The mean value for the skills in each agricultural mechanics area surveyed were calculated as follows:

- Tractor and Machinery Power and Mgt. 3.31
- Welding and Metals 2.80
- Electricity and Electric Motors 2.79
- Concrete 2.72
- Gasoline Engines 2.67
- Carpentry 2.52

All of the skills or abilities in the survey are rated according to their mean value. 4.00 means the skill or ability was considered very valuable by all the farmers surveyed. 0.00 means that all farmers considered the skill or ability to have no value. The mean values are listed below for all the skills surveyed.

3.50 - 4.00

1. Read and interpret operator's manuals for tractors and machinery.
2. Lubricate and service tractors.
3. Safely operate a tractor.
5. Select, operate, adjust, and maintain planters.
6. Operate and maintain an electric arc welder.

3.00 - 3.49

1. Install and adjust a coil, condenser, points, and spark plugs.
2. Make common arc welds in four positions.
3. Understand the principles of hydraulics.
4. Select arc weldings electrodes.
5. Construct and repair buildings and equipment.
6. Select, operate, adjust, and maintain cultivators.
7. Select, operate, adjust, and maintain plows.
8. Selection of fuels, oils, and greases.
9. Select, operate, adjust, and maintain mowers.
10. Laying out a building foundation.
11. Cut with an electric arc welder.
12. Select, operate, adjust, and maintain balers.
13. Select, operate, adjust, and maintain corn pickers.
14. Understand the principles of the two and four cycle engines.
15. Lubricate, service, and maintain small gasoline engines.
16. Select, operate, adjust, and maintain disks.
17. Maintain and replace fuses, time delay, and overload devices.
18. Select, operate, adjust, and maintain grain drills.
19. Select, identify, and figure cost of lumber and building materials.
20. Select, use, install, and maintain electric switches.
22. Select, operate, adjust, and maintain manure spreaders.

2.50 - 2.99

1. Replace and repair inadequate wiring.
2. Select, operate, adjust, and maintain field choppers.
3. Make minor repairs, clean, and service electric motors.
4. Select, operate, adjust, and maintain elevators, augers, and conveyors.
5. Operate and maintain hand power tools.
6. Identify and select nails, screws, and other building hardware.
7. Select wire size for a circuit.
8. Operate and maintain a soldering iron.
10. Understand and wire series, parallel, and combination circuits.
11. Replace and repair inadequate wiring.
12. Braze and weld metal with oxyacetylene.
13. Lay out and cut braces and rafters using the farming square.
14. Bend, cut, file, drill, and square cold metal.
15. Cut and tap threads.
16. Attach and adjust gauges and regulators for gas welding.
17. Set up oxyacetylene welder, light and adjust flames.
18. Selection, application, and maintenance of roofing materials.
19. Operate a timing light.

2.00 - 2.49

1. Cut with oxyacetylene.
2. Shape, bend and cut hot metal.
3. Select proper flux rods and tips for gas welding.
4. Use, adjust, sharpen, and maintain hand woodworking tools.
5. Proper proportioning of ingredients for quality concrete.
7. Understand the operation of the watt-hour meter, voltmeter, and ammeter.
8. Repair and overhaul small gasoline engines.
9. Select, use, and store paint brushes and paint.
10. Overhaul tractor engines.
11. Operate and maintain large power tools.
12. Read a micrometer.

1.99 and Below
1. Select and use glues.

The survey indicated farmers feel that skills and abilities in the tractor and machinery area are the most valuable to them. This is definitely an area where they can tie in a dollar and cent return on their time invested. They find all the areas valuable, but they rate the carpentry areas the lowest.

I feel skills and abilities are very important, but the boys must be exposed to many areas so they will know what's available in all phases of agricultural mechanics. A letter from a farmer helped point out that it is impossible to make the boys experts in these different areas, but that the boys should be made aware of the possibilities in all areas.

The survey points out to me what skills are considered valuable by those in farming. I am in teaching to educate boys the best I know how, and I feel this survey will aid me in reaching this goal.

Farmers see a great need for training programs in farm power as reported in a survey conducted by the Professional Farmers of America. (29:24) Service and repair of their equipment was one of the most frequent complaints expressed against machinery and implement dealers.

... poorly trained or indifferent mechanics and shop personnel were cited in more than 20 cases and were frequently blamed for increasing rather than curing problems. Several said their dealers didn't have enough servicemen, and one said, 'He tries hard but can't keep qualified help.' Another complained, 'He needs a better diesel mechanic.'

Inadequate dealer service facilities and working conditions plus slow repair service were additional sore spots with several tractor owners. One said, 'Servicemen are very careless about scratching paint on hoods, etc.' Several said dealer service work was both slow and sloppy. One user commented, 'Time gets away from him--was supposed to service tractor in winter, but waited till spring work started.'
Another user, dealing with a company store, said, 'We had only minor problems, but they couldn't seem to fix them, took five times to fix some troubles.' Another said his dealer is 'too busy repairing equipment himself--needs more mechanics.'

With the increasing value of the farmer's machinery inventory, increased complexity of the machines and the increased skill necessary to service these units, adequate programs of instruction must be provided. In the area of farm power the need is immediately recognized to go beyond theory. Once theory has been taught, the student must be given hands-on experience. In order to be able to perform the task in an acceptable manner the student must be given a chance to learn under an instructional situation that includes performance as well as theory.

The Future of Farm Machinery

Larger sized equipment of the same basic type and design seem to be what most experts in the farm power field predict. The diesel engine will continue to be the predominate source of power used in agricultural equipment. The profession of farming will be more complicated than ever before in the history of mankind.

George Coneyhy (33:12) recently made predictions of what he felt the 1980's held in store for farm equipment.

In tractor horsepower strategy it takes about a 10 percent increase to be visible and a 20 percent increase is necessary to allow similar operation in the next gear. Thus, a 40 horsepower chore tractor would need eight more by this criterion, while a 200 horsepower unit would need 40 more and a 350 horsepower would require 70 more.

My point is that quantum jumps in larger tractors will be larger. Today a 'large' unit of horsepower sells for about $170, which is cheap--and cheaper than a 'small' horsepower. This means 300 horsepower cost about $51,000
and 450 horsepower will cost about $25,000 more. Obviously, the customer will expect appropriate earning capability for the incremental investment.

What about engines? Despite alternate research, we see the diesel as dominating the next 15 years. The break even point, at which a diesel's capital cost is offset by operating economy, has steadily declined. Europe has already essentially dieselized its agriculture. There will be further diesel progress to accept wider ranges of fuels and reduce noise levels. The 1980's diesel will provide a better power/weight ratio with greater use of turbochargers and intercoolers.

Robert D. Wisemer (53:20), manager of Product Technology, Deere and Company, also commented upon the future of agricultural equipment and its power source.

In Century 21 the farmer will be more completely integrated into the food production and processing segment of agri-business. The farmer will expand his economic base by adding value to his crops through the specific food processing routines he completes. This processing may begin as the crop is transported from field to farmstead, to the shipping terminal, or to the final food processor.

While the diesel engine will remain the main power source for field machines and for the new food processing machines, it will become more efficient, possess a multi-fuel capability, and deliver higher specific power.

Aquaculture--farming the seas--will provide a significant portion of the world food supply in Century 21. Production of kelp using nutrient rich deep seawater is possible but requires the development of mechanical beds, seawater fans or turbines, and harvesters.

Field crops, particularly corn and wheat, will supply new foods. Both crops will produce their own nitrogen, as alfalfa and soybeans now do.

New agricultural machinery systems for the developing countries will place less emphasis on minimizing labor and more on optimizing available resources. In those nations arable land is a limited resource: labor is not. The new systems will enable the farmer to increase production beyond the subsistence level through double cropping, sturdier plants, and more efficient plant maintenance.
Some leaders in the farm power field made predictions of vast changes in the equipment farmers of the future will be using. Some felt the importance of the diesel as a power source would continue while others such as The Society of Agricultural Engineers (48:1) forecast the adoption of new sources of energy.

By the year 2001 field machines will be controlled by computer tapes and guided by buried wires or sensing devices. The width of cropping strips can be matched to the size of the necessary equipment for that crop. Soil compaction thus will cease to be a problem because tractors and other field equipment do not contact the soil areas in which crops are grown. Instead, equipment traffic lanes will be used to improve traction and to channel the rainfall to the crops. A network of subsurface irrigation and sensing wires will be below those traffic lanes.

One operator then can monitor the automated movement of a fleet of field machines from a control tower. Those self-propelled machines can harvest and process one crop as they will simultaneously prepare the seedbed and plant another crop in the same pass. Some airborne equipment can apply fertilizer and chemicals on the larger farms. Land will be double-cropped, even triple-cropped to achieve needed production.

By the year 2001 that field equipment will be powered by nuclear energy or electro-mechanical energy. Solar heating systems are built into the superstructures of buildings to provide energy for crop drying and for human and animal comfort heating.

Farmers will no longer buy individual pieces of equipment but entire systems that provide the appropriate degree of mechanization for their operations. Complete computerized equipment summaries will provide reliable management aids.

The farm equipment dealer will then advise his clients in an increasingly comprehensive scope. He offers insurance. He offers financial, engineering, management and consulting services. He will know worldwide product demand. He will play a key role in his customer's decisions, especially in selecting the proper equipment fleet for an operation--in addition to his traditional role of providing machines, parts, service and equipment.

The Dealer Product Support Center will be equipped to analyze equipment and to diagnose current and potential mechanical failures. The module containing the problem area
can then be replaced during the regular service, inspection and maintenance routine. Thus downtime during the regular productive use cycle can be virtually eliminated.

L. H. Hodges (40:25) Vice-President, Technical Affairs, J. I. Case Company, sees agricultural equipment literally leaving the ground. His predictions of airborne equipment will surely offer unknown challenges to service technicians of the future.

In this century we have seen a trend toward larger and larger tractors and other field equipment to get the work done faster. By Century 21 we will reach the practical limit in machinery size. Then we will see a family of smaller machines in the field. Those machines will be operated and controlled from the mother ship--and the time undoubtedly will come when that mother ship is airborne. Those small field machines will handle a variety of field routines quickly and with minimum soil compaction.

While considerable research already has been done on precision planting, dramatic advances are ahead here. Soon our farmers will be laying prepackaged seed in a continuous tape strip. Each seed will be properly spaced horizontally and vertically for maximum plant growth. Each seed tape will provide also the proper soil nutrients, growth stimulants and pesticides for the emerging plant.

Regardless of the direction farm equipment may take in the future one thing is certain; the need for highly trained service technicians will increase. Persons must be trained to service and repair the new and exciting machines predicted for the future. Development of new ideas and machines can only go as far as people can be trained to service them.

The future seems to be bright for both the designers of new equipment and those expected to repair this machinery.

Development of Instructional Materials

Prehistoric cave dwellers drew pictures of animals and events that influenced their lives thousands of years ago. Those, sometimes,
crude drawings were probably man's first attempt at developing instructional material for others to follow. Today these pictures are doing just that, for they are studied by modern man to give an insight into early life.

John Amos Comenius (55:3) is generally credited with being the father of visual education. His book, *Orbis Pictus* (translated: Visible World or World Illustrated), published in Nuremberg, Germany, in 1657, was the first to use pictures to illustrate points. However, early educators felt young children were not ready for a flood of abstractions, for they would grow merry and willingly suffer.

With the advent of federal money that could be used to develop new instructional materials an upsurge of effort and production occurred. Alkin and Wingard (82:36) pointed this out in a study conducted at the University of California, Los Angeles.

Some of their findings were:

Instructional product development as a technology and commercial enterprise is the progeny of the programmed instruction and curriculum development movements of the late fifties and early sixties. To say that the field has expanded since then demeans the art of understatement. Based on published listings in the Educational Product Information Exchange (EPIE), including only the more popular products, there has been an estimated 48% increase in the number of commercially available products, and an estimated 88% increase in the number of commercial producers from 1967 to 1970. Academically, we have not only witnessed the establishment of over 20 regional laboratories and R&D centers in recent years, but the educational literature is annually deluged with articles describing various schemes and systems models for product development procedures. The complexity of such models vary considerably from general three- and six-stage schemes to comprehensive step-by-step procedural checklist.

The primary focus of much of the past and current R&D activity has been on refining and improving product development technology. This quest for clearly defined and documented development procedures has undoubtedly resulted
in the more efficient production of improved instructional products. However, an important area of the R&D effort, the specification of generally accepted standards for reporting the results of these products to potential users, has been neglected. Consequently, there is a paucity of conveniently assembled and readily interpretable information that would enable users to make accurate and informed evaluations of different, but comparable, instructional products.

With increased technology in agriculture it has become imperative that farmers specialize to increase their scope of production. By the same degree the instructors of agriculture must specialize in these same areas to be of maximum benefit to the student and the farmer. To accomplish this instructional materials must be developed as pointed out by Warmbrod. (51:243)

The provision for appropriate instructional materials as a necessary part of the teaching-learning process has always received high priority in agricultural education. It is not unusual then that increased emphasis on instructional materials development occupies a prominent role in current efforts to strengthen programs of agricultural education. Specifically, much of the current instructional materials development is prompted by the necessity that agricultural education be broadened to include instruction pertaining to all occupations--whether in business, industry, or on the farm and ranch--that involve knowledge and skills in agricultural subjects.

Agricultural education leaders have long seen the need for development of instructional materials in agriculture. The Vocational Education Act of 1963 helped make this a reality by providing funds for their development, as discussed by E. M. Juergenson (42:143), professor of agricultural education at the University of California, Davis.

Instructional materials is probably one of the oldest and most frequently discussed subjects in education. The use of instructional materials has probably influenced learning, for good or bad, as much as any facet of education. While instructional materials can make a teacher better,
they are not substitutes for teaching or teachers. They can serve to spread the teacher's influence to more students or to wider areas.

What constitutes instructional materials? The best answer may be—anything utilized in teaching. The entire gamut of resource material used to assist a teacher in guiding the learning process could probably be classified as instructional materials.

With the advent of the Vocational Education Act of 1963 funds suddenly became available to develop a great many instructional materials, especially in agriculture, including such areas as landscape horticulture, forestry, rural recreation, and the service occupations. Some excellent materials were developed—for example, the modules of courses developed at the Center for Vocational and Technical Education at the Ohio State University. While there may be wider use of these materials than first glance indicates, in too many schools these materials are ordered and lie on shelves unused. It could well be that preparation of instructional materials must in some way involve the teacher who has to use them in order for them to be effective.

Teachers of agriculture have long been surrounded by an array of instructional materials that is the envy of other teachers in the school. Consider the agricultural mechanics shop with its battery of fascinating machines and materials, or the agricultural science room with true-to-life, out-of-doors ownership experiences readily available to appeal to the natural instincts of students. Contrast this, for example, to the situation of the English teacher who has only books with which to work. Have we taken advantage of our materials?

It is important to learn about these instructional aids as they become available and to grow with them. There are obvious advantages, for example, to the use of the single-concept film where an agricultural mechanics student who wants to learn to operate a cutting torch can independently observe a demonstration as often as he needs to; or an agricultural science student who was absent and missed the field trip on pruning can recapture the situation as often as needed. Such films, made by experts, not only free a teacher for other things, but frequently present material more adequately than the local instruction can. Television, compact and simple enough for instructional use, will soon be here. Imagine an instructor or student teacher capturing his class on film so that at the end of the day he can see it re-enacted in order to upgrade his or the student's performance. As modern teachers of agriculture, we must give students every advantage to learn.
There is as little danger of these new aids replacing the teacher as there was when printing was first invented. There is the possibility of improving instruction and spreading the influence of good teachers far beyond our present imagination.

Curriculum development in vocational agriculture appears to be well based in terms of sound educational theory and principles. Adjustments continue to be made that will aid the student in a productive life. Since society is constantly changing the need exists to educate the student for his individual needs rather than train them as a group or all the same way as pointed by James and Porter. (60:21)

It should be emphasized at this point that educational programs of vocational agriculture are said to be most effective when the instruction is centered around the students' educational needs in agriculture rather than around the needs of agriculture. The idea is to educate persons in solving their problems in agriculture and desirable changes in agriculture will be effected. This approach to teaching, based on sound educational principles, may be limited to some extent by the ability of the teachers and students to use it within the framework of a changing agriculture. For instance, in using this approach the problems of students relative to agriculture tend to be those identified within the local community and home farm. This approach, it appears, should continue to be used to its fullest, but consideration must also be given to people's needs relative to agriculture as it relates to other parts of economic and social structure.

Jacks (76:106), in a study to determine teacher attitudes concerning selected policies related to planning, developing, and using subject matter materials, found that the teachers stressed a strong desire for instructional materials developed in a skill sheet operation. Of 276 teachers responding, 86.2 per cent stated they would prefer new materials developed in job operation sheets, information sheets, and similar materials.

The teachers also offered some advice as to how new materials should be developed:
It is an accepted principle that soundly formulated and implemented policies contribute to the attainment of an organization's objectives. Four selected policies were believed to be among those essential to sound planning, developing, and using subject matter materials. The policies deal with:

1. The use of a committee for planning and developing reference material outlines;
2. The use of specialist in technical subject matter fields for reviewing reference material manuscripts prepared by the Mississippi State University Subject Matter Service as a means of securing accuracy and coverage of information;
3. The use of assistance from teacher training and supervisory staffs to help teachers more effectively interpret and use new subject matter materials; and
4. Promoting the retention of major subject matter materials in departmental libraries.

Skill sheets or job operation sheets are student oriented; for they are designed to serve as a step-by-step guide in the performance of a task. For the teacher they are an instrument to assist in directing the learning activities in an organized manner. Their importance in agricultural mechanics is commented on by Clinton Jacobs (61:2), Teacher Education, University of Arizona.

In the vast array of software material which is now available for instruction/training in Agricultural Mechanics, the one instrument which has withstood the test of time for directing the learning process for skill development is the Job Operation Sheet. Unfortunately, there is little standardization among educators either in terminology used to identify the component parts of a job operation sheet or the format which will effectively present to the student/trainee the skills to be developed.

Job operation sheets have been developed by incorporating the merits of the job sheet and the operation sheet used in trade and industrial education during its formative years. A job is complete when the product or process is accomplished. An operation identifies the major activities within the job. The success of completing a job therefore depends upon the ability of the individual to employ the skills involved in the various operations.
Time is a critical element in scheduling classes of vocational agriculture. A wise selection of what to teach must be made, and methods of instruction must be streamlined to secure the maximum amount of learning. This is particularly true of abilities in Agricultural Mechanics. For the teacher, the job operation sheet serves as an outline for student oriented programmed type learning device. When prepared by the teacher, it represents his concern and input for having analyzed the job for the skills to be developed by the student. It also represents his effort to establish a logical set of operation in a sequence which will take the learner through the skill development process in a step-by-step manner. As a teaching device, the job operation sheet applies the Primacy Principle of Learning—that of learning the correct way, first. For the student, the job operation sheet serves as a device for recalling what has been taught, thereby reinforcing his confidence as opposed to reverting to the trial and error process for skill development. Unfortunately, a job operation sheet is a written communication instrument. Reading and comprehension ability of the student will influence the effectiveness of the device when used as the sole teaching tool. Certainly, the job operation sheet must be reinforced with other teaching techniques.

The procedure for developing a job operation sheet involves the construction of an outline of activities which will take the learner through the processes of accomplishing the job in a logical and efficient manner. For pre-employment education, the jobs to be performed by the student should be selected to include those skills which are common to a number of related occupations. Each job to be performed by students has a number of operations which are an integral part of the task. The sequence of listing the operations in the outline must be consistent with practices and procedures as performed by a skilled person.

Evaluation of Instructional Material

Evaluation is commonly used to refer to a great variety of activities connected with educational programs. In its broadest sense it has to do with placing a value or determining the worth of educational courses, materials, or even whole systems.

The foundation of any good evaluation must be preceded by a clear statement of the program objectives. Once this has been done, it is possible to assess the students performance with respect to the degree of success or failure of these goals.
Klein (75:10) reported some of the major problems associated with evaluating material in a paper presented to the American Educational Research Association. His remarks were:

Some of the major problems associated with comparing programs in terms of their relative success on the objectives are as follows:

1. Types of score reported. The number of test items and the method of measurement often varies across objectives both within and between programs. It is necessary, therefore, to convert performance on different objectives to a common scale, such as the average percent correct, average number of students per class achieving mastery, or the average time it takes a student to achieve mastery. There are, of course, other scales that might be used and the choice of which one to use might have a profound influence on the conclusions drawn from the data.

2. Difficulty. Different assessment instruments, even for the same objective, often vary in their difficulty. Thus, one program may appear to be more successful than another program in reaching its objectives simply because it is using easier measures. Thus, whenever possible, the same set of items should be used to assess performance on a given objective if that objective is applicable to different programs.

3. Scaling. The difficulty of 'items' within a test for a given objective usually are not equal nor do they have equal intervals of difficulty between them. For example, it may be easier to improve 10 points near the low end of the score distribution than near the high end.

4. Validity. The more valid a measurement instrument is (i.e., actually measures the objective rather than an approximation of it), the more sensitive it is to changes in student performance. Thus, differences in measurement validity across objectives may create the false impression that some objectives are achieved more than others when the real reason is that the instruments used varied in their ability to assess the precise level of student performance.

5. Reliability. Misleading differences and similarities in student performance across objectives and programs can also be caused by variations in the consistency
with which instruments measure different objectives. The reliabilities of instruments used in most evaluation studies, however, are usually sufficient to minimize this problem, especially when decisions about program effectiveness are based upon group rather than individual scores.

The use of various techniques for comparing the effectiveness of different instructional programs is becoming an important topic in the field of educational evaluation. As Popham (85:6) points out, one reason for this increased interest in program comparison techniques is that instructional programs, promising specified changes in learners, are becoming more plentiful. This means that we now have the opportunity to select from competing instructional programs. Pressure for developing valid and informative program comparison techniques also is coming from major educational funding sources. The funding sources want to know which programs are effective.

Cromwell (34:24) discussed the role of references in teaching-learning situations, the proper and improper use of such materials; and he suggested both physical and content criteria as guidelines for evaluating printed references.

The physical criteria and content criteria listed as some of those to be considered were:

**Physical Criteria**

1. **Binding**—Paper or cloth cover? Sewn, glued, or stapled? Does it open flat? Does it meet rigid BMI specifications?

2. **Paper**—Check weight, opacity, finish, and general quality.

3. **Type**—Is legibility appropriate for the grade level? Do headings stand out? Is size and arrangement economical of space? Check columns, margins, line length. Is text arrangement attractive and easy to read?
4. **Illustrations**—Are they clear, of good size, well chosen to add meaning, and coordinated with the text on the same page?

5. **Color**—Is it functional and in good taste or merely decorative? Can the extra cost be justified?

6. **Design**—Is it attractive and appropriate?

7. **Size**—Number of pages? Cost?

8. **Reference materials**—Check index, tables, appendix.

9. **Auxiliary materials**—Are manuals, study guides, answer keys, related visuals or hardware available.

**Content Criteria**

1. **Author**—Qualifications as subject-matter authority, knowledge of teaching, ability to communicate.

2. **Copyright date**—Number of editions, completeness of revisions.

3. **Philosophy**—Underlying assumptions, approach used.

4. **Writing style**—Reading level, interest level, vocabulary level. Is it tightly written and to the point? Logical and easy to follow.

5. **Coverage of how-to-units**—Skills and process operation.

6. **Coverage of related units**—Necessary information, about modern industry, guidance, management fields, history, general concepts, and related fields.

7. **Usability**—Is the content appropriate for developing skills, understandings, and attitudes?

8. **Safety information**—Separate, integral, or lacking?

9. **Organization**—Is the text teachable?

10. **Comprehensiveness**—Breadth of coverage; depth for each unit.

11. **Study helps**—Italics for emphasis; new words defined, listed and pronounced; review questions and application questions; problems and suggested activities; bibliography.
Troyer and Pace (66:367) commented on the value of evaluation and the uses that should be made of an evaluation. Only by putting to use what has been found will maximum benefit be gained from data collected in the study. Some of the comments were:

Evaluation is of little worth unless the weaknesses it reveals are corrected. All evaluation reveals weaknesses as well as strengths. Who is to correct these weaknesses? Quite obviously, the students must correct deficiencies that apply to them, and the staff must correct deficiencies that apply to the educational program. But will they? They may not. They may produce an elaborate set of arguments to prove that the evaluation was untrustworthy, that the evidence it gathered was suspect and invalid. They are not likely to react in such manner to an appraisal which they have themselves carried out. This is why evaluation, to achieve its purpose, must be so conducted that confidence in the results is built up and readiness to change is fostered. Participation, making evaluation a genuine group enterprise, is one effective means of assuring that results will be put to good use.

Perhaps the role of evaluation is best summarized by Lindvall and Cox (15:55) as they discuss the questions that are raised from an evaluation and what action should be taken:

...evaluation may consider such questions as, 'Is this program good?' and 'Is it worthwhile to use?' When questions are asked in this form, they can be answered only on the basis of subjective judgment, questions as to value and worth are ultimately questions requiring value judgments of what constitutes the good or worthwhile. The evaluator in his other roles as individual, interested citizen, or educator will make, or help to make, such judgments. In his role as an evaluator, however, he should be prepared to present relatively objective evidence in assessing an innovation. He must be ready to respond to the question, 'What data do we have concerning the results of using this program?' The evaluator's role is to provide information which says that, 'This program is 'good' for these purposes and in these ways' (and/or 'is not good for these things').
CHAPTER III

PRESENTATION AND INTERPRETATION OF DATA

War, pestilence, and famine have been the three traditional scourges of the human race (36:4). They have been nature's brutal ways of keeping the human population of this planet within limits.

The American farmer has done much to alter nature's plan of hardship. With technology he has helped feed the needy throughout the world while maintaining an abundance at home. Many factors contributed to this accomplishment; however, none was greater than the use of agricultural machinery.

The use of highly complex machines and equipment requires instruction in maintenance and repair of this equipment. Teachers of vocational agriculture have assisted in meeting this need by developing instructional programs in the area of agricultural mechanization.

This study was made to analyze certain aspects of the secondary school training programs in farm power. The following objectives served as guidelines:

1. Determine the status of farm power instructional material currently used at the secondary school level.

2. Determine the educational and experience status of instructors currently teaching secondary farm power.

3. Develop instructional materials on tune-up procedures of gasoline farm power units for use by secondary school students.

4. Evaluate the developed subject matter materials using a jury of teachers now teaching in the field of farm power and machinery.
Evaluate the developed subject matter material using classroom instruction with secondary school students.

Formulate recommendations for the development and use of future farm power instructional materials produced in this style.

Instructors' Teaching Experience

Job satisfaction is often indicated by the length of time teachers have remained in their position. The instructors used as participants in this study were a very stable and experienced group, as shown in Table I. The years of teaching service in all educational fields averaged 13.46 years with a range of 2 to 37 years. Their experience in teaching vocational agriculture was slightly less, with an average of 12.9 years of teaching service in this field. As instructors of farm power, their experience ranged from 1 to 37 years with an average of 10.8 years.

School change seemed to be minimal with the group. Years of service in the present school system ranged from 1 to 30 years with the average being 9.74 years without a change.

Data in Table I suggest that the individuals selected for participation in this study were very knowledgable in the field of farm power instruction, with an average of almost eleven years experience; very content in their profession, with an average of thirteen and a half years teaching experience; and successful in their teaching endeavor, with almost ten years tenure in their present school system.
TABLE I
INSTRUCTORS' TEACHING EXPERIENCE

<table>
<thead>
<tr>
<th>Experience</th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Teaching</td>
<td>13.46</td>
<td>2 - 37</td>
</tr>
<tr>
<td>Years Teaching Vocational Agriculture</td>
<td>12.90</td>
<td>1 - 37</td>
</tr>
<tr>
<td>Years Teaching Farm Power</td>
<td>10.80</td>
<td>1 - 37</td>
</tr>
<tr>
<td>Years in Present School System</td>
<td>9.74</td>
<td>1 - 30</td>
</tr>
</tbody>
</table>

Instructors' Educational Attainment

Nearly one-half of the farm power instructors surveyed indicated they now hold the master's degree (44%) as shown in Table II. In addition 26 per cent stated that they were presently working on the master's degree and only 30 per cent were stationary in their education with a bachelor's degree.

The highest degree held was the master's and no one indicated work in progress on a higher degree program.

Although educational achievement has its importance in the field of education, it is not the only criterion for success in teaching. The years of teaching service for the group averaged thirteen and one-half years. This long tenure combined with the fact that 30 per cent of the instructors have suspended their education at the bachelor's degree, suggest they may be seeking further knowledge by other methods.

Instructors were requested to indicate experiences in which they received training in farm power or a related field. The teachers were requested to denote the various jobs, training or educational programs attended and their length or credit.
Data in Table II reveal that 86 per cent of the respondents received some type of home shop training. This seems to indicate that the family background held a strong mechanical affiliation. A greater proportion of instructors stated they had received home shop training than experience from any other source.

Since all respondents held at least a bachelor's degree, college courses were a major source of training. The great majority (80%) of the instructors received some training in the area, probably while in pursuit of a degree. Only 20 per cent stated they had not received college training in farm power.

The average number of farm power courses taken by the instructors was 6.58 with average credit hours of 19.75. The amount of credit hours would constitute a minor in most undergraduate degree programs.

Inservice courses were another important source of training for secondary school instructors of farm power. Nearly three-fourths (74%) of the teachers reported they had attended some inservice workshops on farm power. The number of training programs attended by
<table>
<thead>
<tr>
<th><strong>Home Shop Training</strong></th>
<th>Yes</th>
<th>No</th>
<th>Average Number Of Years</th>
<th>Average Credit Hours</th>
<th>Average Number Of Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>43</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per cent</td>
<td>86</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High School Vo. Ag. Training</strong></td>
<td>Yes</td>
<td>No</td>
<td>Average Number Of Years</td>
<td>Average Credit Hours</td>
<td>Average Number Of Courses</td>
</tr>
<tr>
<td>Number</td>
<td>34</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per cent</td>
<td>68</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vocational Trade School</strong></td>
<td>Yes</td>
<td>No</td>
<td>Average Number Of Years</td>
<td>Average Credit Hours</td>
<td>Average Number Of Courses</td>
</tr>
<tr>
<td>Number</td>
<td>5</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per cent</td>
<td>10</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>College</strong></td>
<td>Yes</td>
<td>No</td>
<td>Average Number Of Years</td>
<td>Average Credit Hours</td>
<td>Average Number Of Courses</td>
</tr>
<tr>
<td>Number</td>
<td>40</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per cent</td>
<td>80</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>Yes</td>
<td>No</td>
<td>Average Number Of Years</td>
<td>Average Credit Hours</td>
<td>Average Number Of Courses</td>
</tr>
<tr>
<td>Number</td>
<td>13</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per cent</td>
<td>26</td>
<td>74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Employment in Industry</strong></td>
<td>Yes</td>
<td>No</td>
<td>Average Number Of Years</td>
<td>Average Credit Hours</td>
<td>Average Number Of Courses</td>
</tr>
<tr>
<td>Number</td>
<td>24</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per cent</td>
<td>48</td>
<td>52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inservice Training</td>
<td>Yes</td>
<td>No</td>
<td>Average Number Of Years</td>
<td>Average Credit Hours</td>
<td>Average Number Of Courses</td>
</tr>
<tr>
<td>Number</td>
<td>37</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per cent</td>
<td>74</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Not Apply*
the instructors averaged 5.62. Thirteen (26%) reported they had not attended inservice training in the area.

Data collected in this study, like others reviewed, indicate that the majority of instructors have received high school training in vocational agriculture. Thirty-four instructors (68%) indicated they had enrolled in a secondary program of vocational agriculture for an average of 3.6 years. The remaining 32 per cent received no high school training through vocational agriculture.

Responses of the instructors, with reference to employment in industry, showed nearly half (48%) had been employed in the farm power field. The length of employment ranged from 1 to 20 years with a mean of almost six years (5.8) for the group. Fifty-two per cent stated that they had no employment experience in a farm power field.

The large percentage of past employment in industry suggests that the group has a knowledge of the needs of employers as well as the students they are training.

Only thirteen (26%) of the respondents reported they had received farm power training in any branch of the military services. The average length of service was 4.07 years for the instructors receiving military training in this area. The mean was somewhat enlarged due to the fact that several of the instructors had spent more than 20 years in the service.

Vocational trade schools were the least used by the instructors to gain experience in farm power. Only 5 (10%) reported they had attended trade school for this purpose. One factor for the relatively low percentage is the fact that post-secondary vocational programs are
generally offered to meet the needs of job-oriented youth with apparent
disregard for further education.

Data from this study seem to indicate that farm power instructors are well experienced in their field. The traditional methods of training such as college was one way knowledge was gained, as data show many had previously found employment in trades and industrial jobs. Other sources such as military and vocational trade school training offered the instructors invaluable hands-on experience.

Adequacy of Instructor Farm Power Training

An instructor can teach only what he knows. In order to
determine the adequacy of training received, the instructors were
requested to evaluate farm power training received. Response to
adequacy of training with reference to various farm power areas are
presented in Table IV.

For purpose of interpretation, true numbers were assigned to
the weighted means in the following manner:

<table>
<thead>
<tr>
<th>Adequacy</th>
<th>Weighted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Adequate</td>
<td>2.51 - 3.00</td>
</tr>
<tr>
<td>Adequate</td>
<td>1.51 - 2.50</td>
</tr>
<tr>
<td>Limited</td>
<td>0.51 - 1.50</td>
</tr>
<tr>
<td>No Training</td>
<td>0.00 - 0.50</td>
</tr>
</tbody>
</table>

As a group, instructors felt that they had received adequate
training in four farm power areas: shop orientation, principles of
engine operation, overhaul of major engine components, and electrical
systems. No instructor reported not having received training in
shop orientation. Only one failed to receive training in principles
of engine operation, two lacked training in the overhaul of major
engine components and four reported no training in electrical systems.
### TABLE IV

**ADEQUACY OF TRAINING AS PERCEIVED BY FARM POWER INSTRUCTORS**

<table>
<thead>
<tr>
<th>Training Area</th>
<th>Very Adequate</th>
<th>Adequate</th>
<th>Limited</th>
<th>No Training</th>
<th>Weighted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Per Cent</td>
<td>No.</td>
<td>Per Cent</td>
<td>No.</td>
</tr>
<tr>
<td>Shop Orientation</td>
<td>16</td>
<td>32</td>
<td>24</td>
<td>48</td>
<td>10</td>
</tr>
<tr>
<td>Principles of Engine Operation</td>
<td>21</td>
<td>42</td>
<td>21</td>
<td>42</td>
<td>7</td>
</tr>
<tr>
<td>Overhaul of Major Engine Components</td>
<td>14</td>
<td>28</td>
<td>16</td>
<td>32</td>
<td>18</td>
</tr>
<tr>
<td>Diesel Fuel Systems</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>Electrical Systems</td>
<td>4</td>
<td>8</td>
<td>22</td>
<td>44</td>
<td>20</td>
</tr>
<tr>
<td>Hydraulic Systems</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td>24</td>
<td>25</td>
</tr>
<tr>
<td>Drive Train Systems</td>
<td>3</td>
<td>6</td>
<td>20</td>
<td>40</td>
<td>18</td>
</tr>
</tbody>
</table>

N = 50

Mean Rating Scale = Very Adequate 2.51 - 3.00
Adequate 1.51 - 2.50
Limited 0.51 - 1.50
No Training 0.00 - 0.50
Three areas had a weighted mean of below 1.51 (Limited). These areas were: drive train systems, hydraulic systems, and diesel fuel systems. Eighteen per cent stated they had received no training in hydraulic systems or drive train systems. Nearly one-fourth (22%) reported a lack of training in diesel fuel systems. This was the lowest rated of the farm power areas with a mean of 1.18. Twenty-three (46%) stated they had received limited training in diesel fuel systems, 12 adequate and only 4 with very adequate training in this area.

The highest rated adequacy of training was principles of engine operation, with a mean of 2.24.

**Types of Farm Power Instructional Programs**

It is generally accepted that the primary objective of secondary vocational school programs is to prepare the high school youth for employment. Vocational programs should be structured to meet the needs of those in training.

As can be seen in Table V, the instructors are going beyond secondary instruction and are serving the out-of-school population as well as the in-school youth. All respondents reported having agricultural laboratory training programs. The number of students enrolled in the programs ranged from 5 to 157 with an average teaching load of 42.1 students.

In addition to the agricultural laboratory programs, 10 teachers reported cooperative training programs with an average enrollment of 10.2 students. Adult education programs were being taught by 12 of the instructors responding. These programs ranged in enrollment from 10 to 30 individuals with an average class size of 19.5.
TABLE V

TYPES OF FARM POWER PROGRAMS CONDUCTED

<table>
<thead>
<tr>
<th>Program</th>
<th>Number of Programs</th>
<th>Number of Students</th>
<th>Average Number of Students</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agri-Lab Training</td>
<td>50</td>
<td>2,105</td>
<td>42.1</td>
<td>5 - 157</td>
</tr>
<tr>
<td>Cooperative</td>
<td>10</td>
<td>102</td>
<td>10.2</td>
<td>2 - 25</td>
</tr>
<tr>
<td>Adult Education</td>
<td>12</td>
<td>234</td>
<td>19.5</td>
<td>10 - 30</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>2,441</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data indicate that the fifty schools had a total of 2,441 students enrolled in farm power classes.

Reference Use in Farm Power Programs

Five sources were identified as being the most commonly used types of farm power reference materials. These sources were (1) State adopted textbooks, (2) American Association for Instructional Materials (A.A.V.I.M.), (3) Industry developed material, (4) State developed material, and (5) Personally developed material.

The instructors were asked to indicate the extent of use for each type of the reference in their instructional program. The rating scale ranged from extensive to no use.

In analyzing the returned responses, the most used reference material is that developed by the teacher. As shown in Table VI, nearly half (48%) of the respondents reported extensive use of
TABLE VI

EXTENT OF REFERENCE USAGE IN FARM POWER INSTRUCTIONAL PROGRAMS

<table>
<thead>
<tr>
<th>Reference</th>
<th>Extensive</th>
<th>Moderate</th>
<th>Some</th>
<th>No Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Adopted Textbook</td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td>A.A.V.I.M. Material</td>
<td>7</td>
<td>16</td>
<td>21</td>
<td>6</td>
</tr>
<tr>
<td>Industry Developed Material</td>
<td>17</td>
<td>18</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>State Developed Material</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Personally Developed Material</td>
<td>24</td>
<td>19</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

personally developed material and only 14 per cent stated some use of this type of teaching aid. All instructors reported use of personally developed material, the only type with this response.

Industry developed materials were also reported as one of the more widely used teaching aids. The response included 34 per cent of the instructors who made extensive use of this type material, 18 per cent who used the material to a moderate extent, 13 per cent who used the material to some extent and only 4 per cent who did not use this type of material.

Thirty per cent of the respondents reported that they made no use of state developed materials. From this data, the conclusion was reached that such materials had not been developed in their state.
Twenty-four per cent used the material extensively, twenty-six per cent moderately, and twenty per cent made some use of state developed material.

A further appraisal of Table VI indicated that only 14 per cent of the instructors used A.A.V.I.M. material extensively, 32 per cent stated they were used to a moderate extent, 42 per cent to some extent and 12 per cent reported they made no use of these materials.

The least used type of materials was state adopted textbooks. Sixty-six per cent reported they made no use of textbooks in their farm power instructional program. Eighteen per cent stated they made some use and only sixteen per cent used textbooks moderately or extensively.

Instructors of farm power seem to prefer use of materials with practical value. This is shown by the preference of materials used in industry (industry developed material) and materials that the instructors developed. It appears that other developers of instructional materials have not met the needs for instruction in farm power on a secondary school level. This is especially true of textbooks, which have been the traditional source of reference for this kind of instruction.

Evaluation of Current Instructional Material

As a means of determining the extent current instructional materials were meeting the needs of farm power instructors, the participants were asked to evaluate various materials used in their training program. The criteria were selected from a review of literature and consultation with associates.
For reference to mean scores, the following scale was used in determining the extent to which instructional materials were meeting program needs as perceived by participants:

<table>
<thead>
<tr>
<th>Level</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Adequate</td>
<td>3</td>
</tr>
<tr>
<td>Adequate</td>
<td>2</td>
</tr>
<tr>
<td>Inadequate</td>
<td>1</td>
</tr>
<tr>
<td>Very Inadequate</td>
<td>0</td>
</tr>
</tbody>
</table>

The statistical technique used for interpretation and presentation of the results of this section of the survey was weighted mean score. The weighted mean for the adequacy was calculated by summing the assigned score for the specific adequacy and dividing by the sum of the respondents who actually check a degree of adequacy. The possible weighted mean could range from a high of 3.00 to a low of 0.00.

For the purpose of interpretation, true numbers were assigned in the following manner:

<table>
<thead>
<tr>
<th>Level</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Adequate</td>
<td>2.51 - 3.00</td>
</tr>
<tr>
<td>Adequate</td>
<td>1.51 - 2.50</td>
</tr>
<tr>
<td>Inadequate</td>
<td>0.51 - 1.50</td>
</tr>
<tr>
<td>Very Inadequate</td>
<td>0.00 - 0.50</td>
</tr>
</tbody>
</table>

Instructors of secondary level farm power programs participating in this study were asked to evaluate the extent to which current instructional material being used met their program needs. The responses and weighted means are portrayed in Table VII.

In every instance the weighted mean for the material is above 1.50, a rating of adequate. No weighted means had a value of above 2.50, a rating of very adequate.

Data indicate that instructional materials currently used by the instructors are basically meeting their needs. One reason for the satisfaction could lie in the fact that forty-eight per cent stated they made extensive use of materials they developed.
<table>
<thead>
<tr>
<th>Material Adequacy</th>
<th>Very Adequate</th>
<th>Adequate</th>
<th>Inadequate</th>
<th>Very Inadequate</th>
<th>Weighted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of material content for teaching farm power at high school level</td>
<td>6</td>
<td>30</td>
<td>14</td>
<td>0</td>
<td>1.84</td>
</tr>
<tr>
<td>Content development</td>
<td>4</td>
<td>33</td>
<td>13</td>
<td>0</td>
<td>1.82</td>
</tr>
<tr>
<td>Understanding stressed in material</td>
<td>1</td>
<td>33</td>
<td>15</td>
<td>1</td>
<td>1.68</td>
</tr>
<tr>
<td>Material in appropriate sized units</td>
<td>2</td>
<td>29</td>
<td>18</td>
<td>1</td>
<td>1.64</td>
</tr>
<tr>
<td>Reading level based on student ability</td>
<td>5</td>
<td>26</td>
<td>15</td>
<td>4</td>
<td>1.64</td>
</tr>
<tr>
<td>Material presented on high school student level</td>
<td>0</td>
<td>29</td>
<td>19</td>
<td>2</td>
<td>1.54</td>
</tr>
<tr>
<td>Material presented in a challenging way</td>
<td>3</td>
<td>27</td>
<td>17</td>
<td>3</td>
<td>1.60</td>
</tr>
<tr>
<td>Illustrations sufficient to meet your and student needs</td>
<td>5</td>
<td>25</td>
<td>19</td>
<td>1</td>
<td>1.68</td>
</tr>
<tr>
<td>Illustrations compatible and they reinforce the script</td>
<td>8</td>
<td>31</td>
<td>10</td>
<td>1</td>
<td>1.92</td>
</tr>
<tr>
<td>Illustrations clear and understandable</td>
<td>6</td>
<td>31</td>
<td>11</td>
<td>2</td>
<td>1.82</td>
</tr>
<tr>
<td>Material clearly identifies major points</td>
<td>4</td>
<td>34</td>
<td>11</td>
<td>1</td>
<td>1.82</td>
</tr>
</tbody>
</table>

(Continued)
TABLE VII (Continued)

<table>
<thead>
<tr>
<th>Material Adequacy</th>
<th>Very Adequate</th>
<th>Adequate</th>
<th>Inadequate</th>
<th>Very Inadequate</th>
<th>Weighted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material content up-to-date</td>
<td>4</td>
<td>34</td>
<td>11</td>
<td>1</td>
<td>1.82</td>
</tr>
<tr>
<td>Material free of confusing or conflicting concepts</td>
<td>4</td>
<td>30</td>
<td>14</td>
<td>2</td>
<td>1.72</td>
</tr>
<tr>
<td>Materials meet instructional needs</td>
<td>3</td>
<td>26</td>
<td>21</td>
<td>0</td>
<td>1.64</td>
</tr>
</tbody>
</table>

N=50  Mean Rating Scale = Very Adequate 2.51 - 3.00
     Adequate 1.51 - 2.50
     Inadequate 0.51 - 1.50
     Very Inadequate 0.00 - 0.50
An overview of the type of materials they desired was given when they were asked for recommendations to assist in the preparation of instructional materials that would meet their needs. A complete listing is given in Appendix I.

Some of the more common and helpful suggestions were:

"Keep your material practical, readable, interesting to the students. A lot of materials have too much theory and go too deep. Build more skill type work into materials. Hands-on training keeps students interested and meets their needs and demands."

"Keep the reading level at a 5th or 6th grade level. Break the units down into sub-units or modules with a variety of activities."

"Material clearly illustrated and easily understood by students would be of value."

"Give us basic pictures and descriptions and perhaps miniature models to use and display."


The desire for teaching materials with practical, hands-on experience theme was expressed by most of the teachers. To be of maximum effect, farm power instruction must be based on this type of teaching technique to produce a student with skills necessary to enter the world of work.

To obtain an overall evaluation of the developed material, instructors were asked to assign a rating to the instructional material, as shown in Table VIII.

Twenty-nine instructors (58%) felt the instructional materials on tune-up procedures for farm power units deserved a rating of good. Of the remaining instructors, 36 per cent judged the material to be superior, 6 per cent of fair value and a rating of poor was not given.
TABLE VIII
OVERALL RATING OF DEVELOPED MATERIAL

<table>
<thead>
<tr>
<th>Rating</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td>Good</td>
<td>29</td>
<td>58</td>
</tr>
<tr>
<td>Fair</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

For instructional material to be used in the classroom there must be a felt need for it. Too often materials are produced for their economic value with little regard given to the needs of teachers or students.

The teachers' opinions regarding the need for instructional material developed in this style is shown in Table IX. As can be seen an overwhelming majority (96%) felt there was a need for this type of material in their farm power instructional programs. Only 4 per cent of the respondents stated there was no need for this type of material in their program.

The responses of the instructors show a strong desire for materials structured for in-the-shop use that the students can follow and understand.

Data gathered for this study indicated that teachers preferred instructional material to be grouped in individual units or similar topics bound together. Fifty-two per cent of the instructors stated
TABLE IX
NEED FOR MATERIAL

<table>
<thead>
<tr>
<th>Response</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>48</td>
<td>96</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

yield preferred material to be packaged in individual units. Forty-four per cent reported they preferred similar topics bound together and only four per cent would like all units bound in one copy.

The information given in Table X supports the fact that teachers of farm power desire material that is suited to the instructor's personal use and teaching technique.

TABLE X
PREFERENCE FOR PRESENTING MATERIAL

<table>
<thead>
<tr>
<th>Preference</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Units</td>
<td>26</td>
<td>52</td>
</tr>
<tr>
<td>All Units Bound in One Copy</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Similar Topics Bound Together</td>
<td>22</td>
<td>44</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>
Often the way the material is bound will determine the teaching approach and ultimate use of instructional material. As shown in Table XI, the instructors desired material they could control. Sixty-six per cent stated they would like instructional material of this type to be in loose-leaf notebook form. Hardback binding was not preferred and only 18 per cent desired a soft cover and 16 per cent a spiral binding.

**TABLE XI**

PREFERENCE FOR MATERIAL BINDING

<table>
<thead>
<tr>
<th>Binding</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose-leaf Notebook</td>
<td>33</td>
<td>66</td>
</tr>
<tr>
<td>Soft Cover</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Hardback</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spiral Binding</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The majority of farm power instructors desire material that they can arrange. The loose-leaf notebook allows for additions, or changes applicable to individual program use.

As shown earlier the instructors make more use of materials they have developed. These data indicate the importance placed on such materials. By use of loose-leaf notebooks, teachers may add material they have developed to enrich or support instructional material produced by others.
The instructors were asked to give their perception of strong and weak points of material presented. The results are given in Table XII.

Data show the material had seven main strong points as perceived by the respondents. The highest rated strong point was that the materials reading level was based on student ability (34%). The second highest rated point was that the material was presented on high school student level (30%). These findings coincide with earlier data stating these two points to be very adequate for the instructors needs.

Other strong points brought out by the instructors were that the material clearly identified major points (26%), illustrations were clear and understandable (27%) and that illustrations were compatible and reinforced the script (22%).

The fact that the illustrations met instructor and student needs and that the material was in appropriate size units was indicated also as strong points by the respondents.

Two areas were deemed major weak points in the developed material by the instructors. Thirty-two per cent of the respondents felt the material was not presented in a challenging way. Twenty percent of the instructors indicated weakness in the fact that the material content was not up-to-date. Several instructors made comments that all new tractors have diesel engines and instruction in ignition systems is becoming less important.

Theory and practice must be balanced in a farm power curriculum. Success in this field comes from performing the job and knowing the
### TABLE XII

**INSTRUCTORS' PERCEPTION OF THE DEVELOPED INSTRUCTIONAL MATERIALS WEAK AND STRONG POINTS**

<table>
<thead>
<tr>
<th>Material Points</th>
<th>Strong Points</th>
<th>Weak Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content development</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Understanding stressed in material</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Material in appropriate sized units</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Reading level based on student ability</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Material presented on high school student level</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Material presented in a challenging way</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Illustrations sufficient to meet teacher and student needs</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Illustrations compatible and they reinforce the script</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Illustrations clear and understandable</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Material clearly identifies major points</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Material content up-to-date</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Material free of confusing or conflicting concepts</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Materials meet instructional needs</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

N=50
theory behind it. To accomplish these goals the instructor naturally seeks instructional material that will aid him in his task.

Instructional aids, in order to be most effective, must meet the demands for which they were intended. To determine if the material developed in this study met the needs of farm power instructors, teachers were asked to compare them to established farm power reference sources. The prepared instructional materials were compared with five major sources: state adopted textbooks, A.A.V.I.M. material, state developed material, industry developed material and personally developed material.

The instructors were asked to rate the developed material with reference to each material source. The rating scale used for the developed material was:

- Far Superior
- Superior
- Same
- Inferior

The result of the instructors comparison is given in Table XIII.

<table>
<thead>
<tr>
<th>Material Sources</th>
<th>Developed Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>State adopted textbook</td>
<td>29</td>
</tr>
<tr>
<td>A.A.V.I.M.</td>
<td>8</td>
</tr>
<tr>
<td>State developed material</td>
<td>19</td>
</tr>
<tr>
<td>Industry developed material</td>
<td>6</td>
</tr>
<tr>
<td>Personally developed material</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Far Superior</th>
<th>Superior</th>
<th>Same</th>
<th>Inferior</th>
</tr>
</thead>
<tbody>
<tr>
<td>State adopted textbook</td>
<td>29</td>
<td>16</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>A.A.V.I.M.</td>
<td>8</td>
<td>27</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>State developed material</td>
<td>19</td>
<td>15</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Industry developed material</td>
<td>6</td>
<td>25</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Personally developed material</td>
<td>9</td>
<td>16</td>
<td>24</td>
<td>1</td>
</tr>
</tbody>
</table>
The results of the study indicate the developed material was superior to all listed instructional sources except personally developed material.

The material was highest rated when compared to state adopted textbooks. Fifty-eight per cent of the instructors rated the developed material far superior, thirty-two per cent superior, and only ten per cent said it was the same. The material was not rated inferior to state adopted textbooks.

The next highest, far superior rating, came from the material comparison with state developed materials. Thirty-eight per cent stated the developed material was far superior, fifty per cent rated it superior, thirty per cent rated it the same and eight per cent rated it inferior to state developed material.

Materials developed within the states were perhaps the hardest to compare since each is developed on a different style. The materials range from elaborate visual aid systems to simple lists giving performance guides. Some instructors, however, did comment that the developed material would complement material in their state if they were used together.

When the developed materials were compared to materials developed by industry the following was found. Half of the instructors (50%) felt the developed material was superior, twelve per cent rated it far superior, thirty per cent the same and four per cent rated the developed material inferior to industry developed material.

Perhaps the American Association for Vocational Instructional Material (A.A.V.I.M.) has done as much or more to provide quality
instructional material for secondary education than any other instructional aid source.

When the farm power instructors were asked to compare the developed material to that of A.A.V.I.M. fifty per cent rated the developed material superior. Twelve per cent stated it was far superior, thirty per cent the same and eight per cent stated it was inferior to A.A.V.I.M. material.

One reason for the ratings given by the farm power instructors could be the intended use of the materials. The material developed by A.A.V.I.M. is for use by all segments of agricultural education. The materials have a broad range of applications from ninth grade agricultural students to graduate level college courses. This fact along with the preference for personally developed material could account for the rating.

The comparison of the developed material with personally developed material revealed a 50-50 split, half rated the material superior (32%) or far superior (18%) and half rated it the same (48%) or inferior (2%). This rating substantiates the fact that farm power instructors place great store in materials they have developed. The data seem to indicate that the instructors perceive the developed material in a positive way. In spite of the apparent recognized need for teaching materials in farm power, it is surprising to find that an inadequacy rating was given to recognized material sources.

Each instructor has different needs and preferences when selecting instructional materials for use in his program. Instructional material must be flexible to allow for various teaching programs. Attention must be given to new innovations and teaching techniques
that include terminology such as programmed instruction, modular scheduling, flexible scheduling, computerized instruction, learning activity package, and other systems designed to improve the efficiency and effectiveness of teaching.

A very high percentage of the respondents felt the developed material would meet their program needs, as shown in Table XIV. The participants were asked to evaluate various aspects of the developed material as it related to their instructional program. The evaluation criteria were selected by the writer from a review of literature and consultation with associates.

For reference to mean scores, the following scale was used:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Adequate</td>
<td>3</td>
</tr>
<tr>
<td>Adequate</td>
<td>2</td>
</tr>
<tr>
<td>Inadequate</td>
<td>1</td>
</tr>
<tr>
<td>Very Inadequate</td>
<td>0</td>
</tr>
</tbody>
</table>

The statistical technique used for interpretation and presentation of data was weighted mean score. For the purpose of interpretation, true numbers were assigned to weighted means score in the following manner:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Adequate</td>
<td>2.51 - 3.00</td>
</tr>
<tr>
<td>Adequate</td>
<td>1.51 - 2.50</td>
</tr>
<tr>
<td>Inadequate</td>
<td>0.51 - 1.50</td>
</tr>
<tr>
<td>Very Inadequate</td>
<td>0.00 - 0.50</td>
</tr>
</tbody>
</table>

One of the two largest weighted means (2.56) was for the fact that the reading level was based on the students ability, an overall rating of very adequate. Thirty instructors (60%) felt the reading level would meet their program needs very adequately, thirty-six percent stated it was adequate for their program and four percent reported it inadequate. Since the material was developed using a very elementary
<table>
<thead>
<tr>
<th>Material Adequacy</th>
<th>Very Adequate</th>
<th>Adequate</th>
<th>Inadequate</th>
<th>Very Inadequate</th>
<th>Weighted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content development</td>
<td>16</td>
<td>33</td>
<td>1</td>
<td>0</td>
<td>2.30</td>
</tr>
<tr>
<td>Understanding stress in material</td>
<td>22</td>
<td>26</td>
<td>2</td>
<td>0</td>
<td>2.40</td>
</tr>
<tr>
<td>Material in appropriate sized units</td>
<td>20</td>
<td>29</td>
<td>1</td>
<td>0</td>
<td>2.38</td>
</tr>
<tr>
<td>Reading level based on student ability</td>
<td>30</td>
<td>18</td>
<td>2</td>
<td>0</td>
<td>2.56</td>
</tr>
<tr>
<td>Material presented on high school student level</td>
<td>27</td>
<td>23</td>
<td>0</td>
<td>0</td>
<td>2.54</td>
</tr>
<tr>
<td>Material presented in a challenging way</td>
<td>11</td>
<td>34</td>
<td>5</td>
<td>0</td>
<td>2.12</td>
</tr>
<tr>
<td>Illustrations sufficient</td>
<td>26</td>
<td>23</td>
<td>1</td>
<td>0</td>
<td>2.50</td>
</tr>
<tr>
<td>Illustrations compatible and reinforce the script</td>
<td>28</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>2.56</td>
</tr>
<tr>
<td>Illustrations clear and understandable</td>
<td>27</td>
<td>20</td>
<td>2</td>
<td>1</td>
<td>2.46</td>
</tr>
<tr>
<td>Material clearly identifies major points</td>
<td>27</td>
<td>22</td>
<td>1</td>
<td>0</td>
<td>2.52</td>
</tr>
</tbody>
</table>

(Continued)
TABLE XIV (Continued)

<table>
<thead>
<tr>
<th>Material Adequacy</th>
<th>Very Adequate</th>
<th>Adequate</th>
<th>Very Inadequate</th>
<th>Inadequate</th>
<th>Weighted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material content up-to-date</td>
<td>11</td>
<td>36</td>
<td>3</td>
<td>0</td>
<td>2.16</td>
</tr>
<tr>
<td>Material free of confusing or conflicting concepts</td>
<td>15</td>
<td>35</td>
<td>0</td>
<td>0</td>
<td>2.30</td>
</tr>
<tr>
<td>Materials meet instructional needs</td>
<td>19</td>
<td>30</td>
<td>1</td>
<td>0</td>
<td>2.36</td>
</tr>
</tbody>
</table>

N=50  Mean Rating Scale  =  
Very Adequate  2.51 - 3.00  
Adequate  1.51 - 2.50  
Inadequate  0.51 - 1.50  
Very Inadequate  0.00 - 0.50
reading level a concern for the students' ability seems to be indicated by the instructors.

The other material area with a mean score of 2.56 was for "Illustration compatible and reinforce the script." All instructors rated this area to be very adequate (56%) or adequate (44%).

One other evaluation criterion was rated very adequate for program needs by the instructors, "Material clearly identifies major points," with a mean of 2.52. The criterion "Illustrations sufficient to meet teacher and student needs," only lacked .01 to be rated very adequate, the criterion having a weighted mean of 2.50. All remaining evaluation criteria had a weighted mean value of adequate.

In order to determine how many copies teachers would need of the developed materials the instructors were asked to state the number of students enrolled in the individual instructional situation. As can be seen in Table XV eighty-four per cent stated they would require one copy per student. Six per cent said they would need one copy per two students and ten per cent stated their need was one copy per three to five students.

Given these facts and the number of students in the programs (2,441, Table V) the estimated number of copies for the fifty instructors can be calculated, as shown in Table XVI.

The number of copies needed by the eighty-four per cent using one copy per student would total 2,051 students and 2,051 copies. The six per cent reporting a need of one copy per two students would have a calculated student number of 146 and need 73 copies of the developed material.
### TABLE XV

**NUMBER OF INSTRUCTIONAL MATERIAL COPIES INSTRUCTORS NEEDED**

<table>
<thead>
<tr>
<th>Number of Copies</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>One copy per student</td>
<td>42</td>
<td>84.0</td>
</tr>
<tr>
<td>One copy per two students</td>
<td>3</td>
<td>6.0</td>
</tr>
<tr>
<td>One copy per three to five students</td>
<td>5</td>
<td>10.0</td>
</tr>
<tr>
<td>Less copies</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total (N)</strong></td>
<td>50</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### TABLE XVI

**ESTIMATED MATERIAL COPIES REQUIRED FOR SAMPLE INSTRUCTIONAL PROGRAMS**

<table>
<thead>
<tr>
<th>Program Need</th>
<th>Per Cent</th>
<th>Number of Students</th>
<th>Number of Copies</th>
</tr>
</thead>
<tbody>
<tr>
<td>One copy per student</td>
<td>84.0</td>
<td>2,051</td>
<td>2,051</td>
</tr>
<tr>
<td>One copy per two students</td>
<td>6.00</td>
<td>146</td>
<td>73</td>
</tr>
<tr>
<td>One copy per three to five students*</td>
<td>10.0</td>
<td>244</td>
<td>61</td>
</tr>
<tr>
<td>Less copies</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>2,441</td>
<td>2,185</td>
</tr>
</tbody>
</table>

*Calculated on one copy per four students*
A calculated student enrollment of 244 by the 10 per cent using one copy per three to five students would have a need for 61 copies of the material. The fifty instructors, having a total enrollment of 2,441 students, would need an estimated 2,181 copies of the developed material to meet their instructional needs.

These figures and the instructors' approval of the material seem to indicate a ready market for materials developed in this style.

In an attempt to ascertain the instructors' desires for material developed in this style the teachers were asked if they would like to see additional material developed using this technique. Table XVII shows the instructors' responses.

TABLE XVII

DESIRE FOR ADDITIONAL DEVELOPED MATERIAL

<table>
<thead>
<tr>
<th>Response</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>48</td>
<td>96.0</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>4.0</td>
</tr>
<tr>
<td>Total (N)</td>
<td>50</td>
<td>100.0</td>
</tr>
</tbody>
</table>

To ascertain the most effective use of the developed material the instructors were asked to give their preference for method of use of the materials in their program.

As can be seen in Table XVIII, some choose two methods of use. This dual choice indicated the instructors were of the opinion that the material could be used in a variety of ways.
### TABLE XVIII

**MOST EFFECTIVE USE OF INSTRUCTIONAL MATERIAL**

<table>
<thead>
<tr>
<th>Use</th>
<th>Number*</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>For classroom teaching to an entire class</td>
<td>18</td>
<td>36.0</td>
</tr>
<tr>
<td>For classroom teaching to a small group</td>
<td>6</td>
<td>12.0</td>
</tr>
<tr>
<td>For classroom teaching to individuals</td>
<td>5</td>
<td>10.0</td>
</tr>
<tr>
<td>For individual use in the shop while performing the task</td>
<td>41</td>
<td>82.0</td>
</tr>
</tbody>
</table>

N=50

*NOTE: Several instructors gave a multiple response*

The most popular use of the material was for individuals to use in the shop while performing the task. Eighty-two per cent of the instructors stated the most effective use of the material could be gained in this manner.

The next most popular use was for classroom teaching to an entire class as stated by thirty-six per cent of the instructors.

The least effective use of the material, as reported by the instructors, was for classroom teaching to individuals (10%) and for classroom teaching to a small group (12%).

In all, 70 responses were given by the fifty instructors used in the study. Twenty of the instructors (40%) felt the material had a dual purpose as it applied to their program.

Instructors were requested to list areas in which they desired new instructional material to be developed.
As shown in Table XIX, the farm power area receiving the largest number of requests was electrical systems (34%). Some of the specific requests within the electrical system included battery service, equipment lights, starter service, and generators. Carburetor service ranked second in request by the instructors with 28 per cent desiring new instructional material to be developed in this area.

Significant numbers of instructors also desired new material in diesel mechanics (26%), major engine overhaul (24%) and hydraulic systems (22%).

In all fifteen farm power areas were identified as having a need for development of new instructional materials.

The schools participating in the instructional phase of the study were school districts within the Texas public school system. Farm power instructional programs in Texas are counted as extra teacher units. This means that the enrollment in the class is not used to calculate teacher numbers based on average daily attendance of students.

The program was designed to have low student numbers, thus allowing for personal instruction by the teacher. Its main purpose is to train farm power mechanics by actually performing various tasks on all types of farm equipment.

An initial phase in testing the developed material was a skill test to determine pre- and post-manipulative abilities of the students. All students in the program had received varying amounts of instruction in the three areas under test.
<table>
<thead>
<tr>
<th>Farm Power Area</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical systems</td>
<td>17</td>
</tr>
<tr>
<td>Carburetor</td>
<td>14</td>
</tr>
<tr>
<td>Diesel systems</td>
<td>13</td>
</tr>
<tr>
<td>Major engine overhaul</td>
<td>12</td>
</tr>
<tr>
<td>Hydraulic systems</td>
<td>11</td>
</tr>
<tr>
<td>Filter service</td>
<td>9</td>
</tr>
<tr>
<td>Cooling systems</td>
<td>8</td>
</tr>
<tr>
<td>Brake systems</td>
<td>8</td>
</tr>
<tr>
<td>Valves</td>
<td>7</td>
</tr>
<tr>
<td>Trouble shooting</td>
<td>7</td>
</tr>
<tr>
<td>Bearing service</td>
<td>6</td>
</tr>
<tr>
<td>Drive train systems</td>
<td>6</td>
</tr>
<tr>
<td>Clutch service</td>
<td>4</td>
</tr>
<tr>
<td>Ignition</td>
<td>4</td>
</tr>
<tr>
<td>Lubrication</td>
<td>3</td>
</tr>
</tbody>
</table>

N=50
The initial step was to observe the students remove, replace, and adequately adjust a set of points and condensers. The areas to be judged and graded were:

1. Time required to perform the task.
2. Number of times assistance was required from the instructor.
3. Amount of student error in point setting.
4. Starting of the engine.

Of the twenty-two students in the group only two were able to perform the task. This fact was a surprise to the instructors who felt their students were adequately trained in this area of farm power.

Numerous attempts by the instructors to aid the students through advice and reference aids failed to produce positive results in performing the manipulative pre-test. After a time span of approximately thirty minutes the instructors concluded they were performing the majority of the task for the student.

Due to the fact that the students could not perform the task it was concluded that no valid pre-test scores could be calculated. A possible explanation of this failure was given by one instructor who stated the students usually work as a team. As a group each individual offers advice in areas he might know, and other advice is offered by the instructor when needed.

After completion of the classroom instruction, using the developed material, the skill test was administered again. This time the students were told to use the booklet and follow it step by step as directed. The instructors were available to offer assistance if needed by the students.
The results of the post-test showed that twenty students could perform the task and only two could not. Eighteen additional students were able to perform the task and crank the engine after instruction and use of the developed material.

No statistical procedure was used on the manipulative phase of testing due to two facts; the inability to arrive at a valid pre-test score and the obvious increase in the students' ability in performing the task.

The students seemed to show a large degree of confidence when the booklet was available for consultation. This confidence was shown in the increased number of successes in performing the task.

The farm power instructional programs in the state of Texas are designed for students enrolled in the eleventh and twelfth grade. As can be seen in Table XX this grade placement was not adhered to in the two schools used in the study.

Students from all four secondary grades were placed in the program for various individual and administrative reasons. The largest group of students came from the eleventh grade, Elkhart, with eight students and Westwood with five students. The combined student number totaled thirteen students comprising 59 per cent of the sample.

Students from the tenth and twelfth grade were equal in number, with each having four students. Only one student in the program was classified as being in the ninth grade.

When the student group was analyzed by age it was found that the majority were in the 16 to 17 age range, as shown in Table XXI. The number of students that were 16 or 17 years old comprised 72.7 per cent
TABLE XX

ANALYSIS OF STUDENT GROUP BY GRADE

<table>
<thead>
<tr>
<th>School</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Per Cent</td>
<td>No.</td>
<td>Per Cent</td>
</tr>
<tr>
<td>Elkhart High School</td>
<td>0</td>
<td>0.0</td>
<td>2</td>
<td>9.1</td>
</tr>
<tr>
<td>Westwood High School</td>
<td>1</td>
<td>4.5</td>
<td>2</td>
<td>9.1</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>4.5</td>
<td>4</td>
<td>18.2</td>
</tr>
</tbody>
</table>

TABLE XI

ANALYSIS OF STUDENT GROUP BY AGE

<table>
<thead>
<tr>
<th>School</th>
<th>Age 15</th>
<th>Age 16</th>
<th>Age 17</th>
<th>Age 18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Per Cent</td>
<td>No.</td>
<td>Per Cent</td>
</tr>
<tr>
<td>Elkhart High School</td>
<td>0</td>
<td>0.0</td>
<td>5</td>
<td>22.7</td>
</tr>
<tr>
<td>Westwood High School</td>
<td>1</td>
<td>4.5</td>
<td>4</td>
<td>18.2</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>4.5</td>
<td>9</td>
<td>40.9</td>
</tr>
</tbody>
</table>
of the sample. Only one student was 15 years old (4.5%) and only 5 (22.8%) were 18 years of age.

Classroom instruction, pre-test and post-test, were administered entirely by the two instructors used in the study. Each instructor was free to use the style of instruction he felt would be most appropriate for his group.

The students were informed they would be given a test to determine their knowledge in the three areas under study. It was noted they would not pass or fail but should do the best they could.

After classroom instruction and performing the post manipulate skill test, they were administered the instructional post-test to determine knowledge gained.

A comparison of the mean correct score between pre-test and post-test by areas of subject matter is shown in Table XXII. Also included is the computer "t" test values of the observed differences between the mean test scores.

The statistical procedure used to test the data was the paired observation "t" test. (23:78) The information is paired to eliminate extraneous variance existing from pair to pair. This is done by calculating the variance of the group differences, rather than differences among the individuals within the group.

The null hypothesis was used to test the significance of difference between the pre-test and post-test means. This hypothesis asserts that there is no true difference between pre- and post-test means and any difference found is accidental and unimportant.

To prove that the difference between the pre-test and post-test was statistically significant, the null hypothesis was rejected. A
## TABLE XXII
DIFFERENCES BETWEEN MEAN CORRECT RESPONSES ON PRE-TEST AND POST-TEST BY AREAS OF SUBJECT MATTER

<table>
<thead>
<tr>
<th>Subject Matter Area</th>
<th>Mean Pre-test</th>
<th>Mean Post-Test</th>
<th>Difference</th>
<th>&quot;t&quot; Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributor Service</td>
<td>22.73</td>
<td>39.64</td>
<td>16.91</td>
<td>7.9*</td>
</tr>
<tr>
<td>Spark Plug Replacement</td>
<td>20.00</td>
<td>23.82</td>
<td>3.82</td>
<td>3.94*</td>
</tr>
<tr>
<td>Engine Timing</td>
<td>15.82</td>
<td>20.18</td>
<td>4.36</td>
<td>3.82*</td>
</tr>
<tr>
<td>Combined Areas</td>
<td>58.91</td>
<td>84.55</td>
<td>25.64</td>
<td>10.42*</td>
</tr>
</tbody>
</table>

*Significant at the .001 level

df = 21
critical ratio, or "t" test, of the difference between the two means yielded a specific numerical value. When located on appropriate statistical table (table of t), this numerical value indicated a level of confidence for rejection of the null hypothesis. As shown in Table XXII all "t" values were significant at the .001 level.

Within the limits of this study, it could be concluded that chance differences between the means would occur in only one out of 1,000 cases. Thus, the null hypothesis was rejected with a high degree of confidence.

The largest "t" value (10.42) resulted when comparing the three areas combined. The mean pre-test for the group was 58.91, the post-test 84.55 with a difference of 25.64. Within the separate areas, distributor service yielded the highest "t" value with a value of 7.9. This area had a pre-test mean of 22.73, a post-test mean of 39.64 and a mean difference of 16.91. Spark plug replacement and engine timing yielded very similar "t" values, both were significant at the .001 level.

Within the limits of this study it can be stated that the instructional materials were successful in raising student knowledge in the area of farm tractor tune-up. The null hypothesis that no differences existed between the pre- and post-test was rejected on the basis of the evidence presented.
CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Purpose of the Study

The primary purpose of this study was the development and evaluation of instructional material in the area of farm power. The areas of concern were distributor service, spark plug replacement, and engine timing. A second and equally important purpose was to determine the status of instructional material currently used at the secondary level of education. More specifically the following statements of purpose were used for this study:

1. Determine the status of farm power instructional material currently used at the secondary school level.
2. Determine the educational and experience status of instructors currently teaching secondary farm power.
3. Develop instructional materials on tune-up procedures of gasoline farm power units for use by secondary school students.
4. Evaluate the developed subject matter materials using a jury of teachers now teaching in the field of farm power and machinery.
5. Evaluate the developed subject matter material using classroom instruction with secondary school students.
6. Formulate recommendations for the development and use of future farm power instructional materials produced in this style.
Methodology

The concern of this study was the development and evaluation of instructional materials to aid the vocational agriculture teacher in the instruction of tune-up procedure of gasoline farm power units. To accomplish this purpose the study was divided into three phases.

Phase I -- Fifty teachers were asked to evaluate current instructional materials used in their farm power program and to give recommendations for improvements they felt should be made in new materials being developed.

Phase II - The same fifty teachers reviewed the developed materials and evaluated them for use in their programs. They also compared them to instructional material they were presently using. Recommendations for improvement and new areas in which materials should be developed were also offered by the instructors. Both Phase I and II were conducted by use of a questionnaire.

Phase III of the study was based on teaching research using the "one-group pre-test to post-test" research method (26:230). In this process, the dependent variable (student knowledge) was measured before the independent variable (instructional materials) was applied. The amount of change was then computed for analysis.

SUMMARY AND FINDINGS

The first part of Chapter III was devoted to the description of instructors now teaching farm power, their teaching programs and their evaluations of instructional material used in these programs. Findings are summarized below.
The instructors used as participants in this study were a very stable and experienced group. The years of teaching service in all educational fields average 13.46 years with a range of 2 to 37 years. Their experience in teaching vocational agriculture was slightly less, with an average of 12.9 years. Their experience as farm power instructors ranged from 1 to 37 years with an average of 10.8 years.

Years of service in the present school system ranged from 1 to 30 years with the average being 9.74 years without a change.

Forty-four per cent of the instructors held a Master's degree, twenty-six per cent were presently working on a Master's degree. Only thirty per cent were stationary in their education with a Bachelor's degree. Work beyond the master's was not reported.

Eighty-six per cent of the instructors received home shop training. A greater percentage of instructors stated they had received home shop training than training from any other source.

Eighty per cent of the respondents received farm power training in college. The average number of courses was 6.58 with average credit hours of 19.75.

Nearly three-fourths (74%) of the teachers reported attending inservice workshops on farm power. The number of training programs, attended by the instructors, average 5.62.

Thirty-four instructors (68%) indicated they had been enrolled in a secondary program of vocational agriculture for an average of 3.6 years. The remaining 32 per cent receiving no high school vocational agriculture training follows the trend of instructors coming from non-agriculture oriented backgrounds.
Forty-eight per cent of the instructors had previous employment experience in the farm power field. The length of employment ranged from one to twenty years with a mean of 5.8 years for the group.

Twenty-six per cent of the respondents had received farm power or related training in the military. The average length of service was 4.07 years.

Vocational technical schools were the least used by the instructors to gain experience in farm power, only 10 per cent had attended trade school for this purpose.

In order to determine the adequacy of training the instructors received, they were asked to rate their training. As a group, instructors felt they had received adequate training in four farm power areas, shop orientation, principles of engine operation, overhaul of major engine components and electrical systems.

Three areas had a weighted mean of below 1.51 (limited), drive train systems, hydraulic systems and diesel fuel systems. Eighteen per cent received no training in hydraulics or drive train system and twenty-two per cent reported no training in diesel systems.

When asked the type of instructional program taught, all respondents reported having agricultural laboratory training programs. The number of students enrolled in the programs ranged from 5 to 157 with the average being 42.1 students.

In addition to the agricultural laboratory programs, ten teachers reported cooperative training programs with an average enrollment of 10.2 students.

Twelve instructors reported adult programs ranging in enrollment from 10 to 30 with an average class size of 19.5.
An attempt was made to determine the extent of use for the most common types of instructional materials. Nearly half (48%) of the respondents reported extensive use of personally developed material, 38 per cent reported moderate use, 14 per cent some use, thus all instructors develop materials for use in farm power instruction.

Thirty-four per cent of the instructors made extensive use of industry developed materials, 18 per cent used them moderately, 13 per cent used them to some extent, and 4 per cent made no use of this type of material.

Thirty per cent of the respondents reported that they made no use of state developed material. From this data the conclusion was reached that such materials had not been developed in their state. Twenty-four per cent used the material extensively, twenty-six per cent moderately, and twenty per cent made some use of state developed material.

Fourteen per cent of the instructors used A.A.V.I.M. material extensively, 32 per cent stated they used the material to a moderate extent, 42 per cent some extent and 12 per cent reported they made no use of the material.

The least used of the material sources was state adopted textbooks. Sixty-six per cent reported they made no use of textbooks in their farm power instructional program. Eighteen per cent made some use and only sixteen per cent used textbooks moderately or extensively.

As a means of determining the extent current instructional materials were meeting the needs of farm power instructors, they were asked to evaluate various materials used in their training program.
In every instance the weighted mean for the material was above 1.50, a rating of adequate. No weighted means had a value of above 2.50, a rating of very adequate.

Upon completion of the new instructional material, copies were mailed to the participants for their evaluation. The following is a summary of these data.

Thirty-six per cent of the instructors gave the instructional materials a rating of superior, 58 per cent good, 6 per cent thought the material was of fair value and a poor quality rating was not given.

An overwhelming majority (96%) felt there was a need for this type of material in their farm power instructional program. Only 4 per cent stated there was not a need for this type of material.

Data gathered by this study indicate that teachers preferred instructional material to be grouped in individual units or similar topics bound together. Fifty-two per cent stated they preferred material of this type to be packaged in individual units. Forty-four per cent stated they preferred similar topics bound together and only 4 per cent would like all units bound in one copy.

Sixty-six per cent stated they would like instructional material of this type to be in loose-leaf notebook form. Hardback binding was not preferred and only 18 per cent desired a soft cover and 16 per cent a spiral binding.

To ascertain the most effective use of the developed material the instructors were asked to give their preference for the materials used in their program. Eighty-two per cent of the instructors stated effective use of the material could be gained by the student using the material in the shop while performing the task. The next most popular
use was for classroom teaching to an entire class as stated by 36 per cent of the instructors.

The least effective use of the material, as reported by the instructors, was for classroom teaching to individuals (10%) and for classroom teaching to a small group (12%).

Data show the material had seven main strong points. These points in order were: reading level based on student ability (34%), material presented on high school student level (30%), material clearly identifies major points (20%), illustrations clear and understandable (24%), illustrations compatible and they reinforce the script (22%), illustrations sufficient to meet instructor and student needs (22%), and material in appropriate sized unit (22%).

Two areas were deemed major weak points in the developed material by the instructors. Thirty-two per cent of the respondents felt the material was not presented in a challenging way and 20 per cent placed weakness in the fact that the material content was not up-to-date.

The results of the study indicated the developed material was superior or far superior to all listed instructional sources except personally developed material.

When the material was compared to state adopted textbooks 58 per cent of the instructors rated the developed material far superior, 32 per cent superior, and only 10 per cent said it was the same.

As compared to state developed material 38 per cent stated the developed material was far superior, 50 per cent rated it superior, 30 per cent rated it the same and only 8 per cent rated it inferior to state developed material.
Half the instructors (50%) felt the developed material was superior to industry material, 12 per cent rated it far superior, 30 per cent the same and only 4 per cent inferior.

When the instructors were asked to compare the developed material to that of A.A.V.I.M. 50 per cent rated the material superior, 12 per cent stated it was far superior, 30 per cent the same and 8 per cent stated it was inferior to A.A.V.I.M. material.

The comparison of the developed material with personally developed material revealed a 50-50 split, half rated the material superior (32%) or far superior (18%) and half rated it the same (48%) or inferior (2%).

Data show the developed material would meet the need of farm power programs at a secondary level. Sixty per cent of the instructors felt the reading level would meet their program needs very adequately, 36 per cent stated it was adequate for their program.

All instructors stated the illustrations were compatible and reinforced the script very adequately (56%) or adequate (44%).

Forty-eight (96%) of the farm power instructors reported a desire to see additional material developed. These major areas of desire included, electrical systems (34%), carburetor service (28%), diesel systems (26%), major engine overhaul (24%), and hydraulic Systems (22%).

The schools participating in Phase III of the study were school districts within the Texas public school system. The program was designed to have low student numbers to allow personal instruction by the teacher. Its main purpose is to train farm power mechanics by actually performing various tasks on all types of farm equipment.
Students from all four secondary grades were placed in the program for various individual and administrative reasons. The largest number of students came from the eleventh grade, this group comprised 59.1 per cent of the sample. Students from the tenth and twelfth grades were equal in number, each group making up 4.5 per cent of the sample.

When the group was analyzed by age it was found that the majority were in the 16 to 17 age range (72.7%). Only one student was 15 years old (4.5%) and only 5 (22.8%) were 18 years of age.

A comparison of the mean correct score between pre-test and post-test yielded significant differences. The largest "t" value (10.42) resulted when comparing the three areas combined. The mean pre-test for the group was 58.91, the post-test 84.55 with a difference of 25.64. Within the separate areas, distributor service yielded the highest "t" value with a value of 7.9.

All "t" values were significant at the .001 level. Within the limits of this study it can be stated that the instructional materials were successful in raising student knowledge in the area of farm tractor tune-up.

CONCLUSIONS

Conclusions are based on the findings of this study and presented according to the objectives stated for conducting the research.

Determine the Status of Farm Power Instructional Material Currently Used at the Secondary School Level

1. Instructors of farm power prefer to use instructional materials with practical value. This is shown by the preference of materials used in industry and materials
the instructors developed. It appears that other developers of instructional material have not met the needs for instruction in farm power on a secondary school level. This is especially true of textbooks, which have been the traditional source of reference for such instruction.

2. The most used reference material is that developed by the teacher. Extensive use of this type of material was reported by nearly half of the instructors.

3. The least used type of material was state adopted textbooks. Two-thirds of the instructors reported they made no use of textbooks in their farm power instructional program.

4. Instructional materials currently used by the instructors are basically meeting their needs. One reason for the satisfaction could lie in the fact that a large percentage of teachers are using extensively materials they developed. The desire for teaching materials with practical, hands-on experience was expressed by most of the teachers.

**Determine the Educational and Experience Status of Instructors Currently Teaching Secondary Farm Power**

1. Farm Power instructors as a whole are well experienced and qualified in their field. The traditional methods of training such as coursework were used in gaining knowledge. Data show many instructors had found employment previously in trades and industrial jobs. Other sources such as military and vocational trade school training offered the instructors invaluable hands-on experience.
2. Family background was a strong factor in the instructor's choice of a career in the field of tractor mechanics. A greater proportion of instructors stated they had received home shop training than experience from any other field.

3. The instructors were very well trained through formal education. The average instructor had earned enough college credit hours in farm power to constitute a minor in most undergraduate degree programs.

4. Industry employment was a very important source of training, as shown by the fact that nearly half of the instructors had been employed in the farm power field. This large percentage with past employment in industry suggests that many teachers have a knowledge of the needs of employers as well as the students they are training.

5. Vocational trade schools were the least used by the instructors to gain experience in farm power. One factor explaining the low attendance is the fact that post-secondary vocational programs are generally offered to meet the needs of job oriented youth with apparent disregard for further education.

6. The instructors used as participants in this study were a very stable and experienced group. The individuals selected for participation in this study were very knowledgeable in the field of farm power instruction, with an average of almost eleven years experience; very content in their profession, with an average of thirteen and a half years
teaching experience; and successful in their teaching endeavor, with almost ten years tenure in their present school system.

7. The fact that one-third of the instructors have suspended their education at the bachelor's degree, suggest they may be seeking further knowledge by other methods. This is supported by the apparent success and long tenure in their present school systems.

8. As a group, instructors felt they had received adequate training in four farm power areas; shop orientation, principles of engine operation, overhaul of major engine components and electrical systems. They felt they had received limited training in, drive train systems, hydraulic systems, and diesel fuel systems.

**Develop Instructional Materials on Tune-up Procedures of Gasoline Farm Power Units for Use by Secondary School Students**

Instructional materials developed and prepared by this writer for this report was accepted favorably by the secondary instructors of farm power. It was concluded that instructional material of this style will aid the teacher and students involved in secondary farm power instruction.

The techniques used in the production of this material was non-sophisticated and could be produced by most educational material centers. With a small amount of training, farm power instructors should be able to develop and produce professional quality instructional material suited to their particular program use.
Evaluate the Developed Subject Matter Materials Using a Jury of Teachers Now Teaching in the Field of Farm Power and Machinery

1. Justification does exist for materials developed in the style used in this study. An overwhelming majority felt there was a need for this type of material in their farm power instructional program. The responses of the instructors showed a strong desire for materials structured for in-the-shop use that the student can follow and understand.

2. Data show the material had several main strong points. The highest rated point was that the materials reading level was based on student ability. The second highest rated point was that the material was presented on high school student level. Other strong points brought out by the instructors were that the material clearly identified major points, illustrations were clear and understandable and that illustrations were compatible and reinforced the script.

3. Two areas were deemed major weak points in the developed material. Instructors indicated the material was not presented in a challenging way and that the material content was not up-to-date. Several instructors made comments that all new tractors have diesel engines and instruction in ignition systems is becoming less important.

4. The results of the study indicated the developed material was superior or far superior to all listed instructional sources except personally developed material. The material
was highest rated when compared to state adopted textbooks. The next highest rating came from the material comparison with state developed materials.

Materials developed within the state were perhaps the hardest to compare since each is developed on a different style. The materials range from elaborate visual aid systems to simple lists giving performance guides. Some instructors, however, did comment that the developed materials would complement material in their state if they were used together.

5. Farm power instructors place great store in materials they have developed. The comparison of the developed material with personally developed material revealed a 50-50 split; half rated the material superior or far superior and half rated it the same or inferior.

6. The most popular use of the developed material was for individuals to use in the shop while performing the task. The next most popular use was for classroom teaching to an entire class. This fact suggests the material has a multiple use adding additional value to its educational effect.

7. The large percentage of instructors wanting to see additional material developed (96%) seem to indicate an area of need for developers of instructional materials. With the number of existing farm power programs and states adding or expanding programs, a ready market for material developed in this style seems to exist.
Evaluate the Developed Subject Matter Material Using Classroom Instruction With Secondary School Students

1. Within the limits of this study it can be stated that when the developed instructional materials were used in the shop successful student proficiency in the area of farm tractor tune-up was enhanced. This is especially true in the cognitive knowledge of the student. The null hypothesis that no differences existed between the pre- and post-test was rejected when all "t" values were significant at the .001 level.

2. Based on the increased student performance, skill proficiency in point and condenser replacement was improved. No statistical procedure was used on the manipulative phase of testing, however, the increased number of successes in performing the task with use of the material indicated the material was responsible for the increase.

RECOMMENDATIONS

Recommendations for this study are made with the understanding that a great variation exists in farm power instructional programs among the various states. It is realized that the recommendations for improvement of the secondary programs may have to be slightly modified to meet the unique needs of each State, University, and Secondary program.

This study did reveal patterns upon which to base recommendations for improvements in farm power instruction. Recommendations based on interpretation of the data presented in this study follow:
1. Additional farm power instructional material should be developed using the style of step-by-step sequence with pictures to illustrate the proper procedure. Areas with the greatest need for new material development are:

   Electrical systems
   Carburetor service
   Diesel systems
   Major engine overhaul
   Hydraulic systems

2. Secondary teachers of farm power should be used as consultants in all phases of the development of new material to be used at this level of instruction.

3. New farm power instructional materials should be produced in loose-leaf notebook form. This allows for additions, or changes to be accomplished for individual program use.

4. New farm power instructional material should be current in its technical information. Instructional materials now in use to train industrial shop personnel should be used as a reference in the development of new materials.

5. Cooperation between teacher educators and mechanization instructors should exist for maximum student benefits and training. Both departments should determine the requirements necessary for training secondary farm power instructors.
6. University course offerings and vocational agricultural curriculums should be examined to determine if student preparation is sufficient to train farm power instructors.

7. Additional college courses should be offered to better train vocational agriculture teachers in the area of farm power machinery. These courses should center around drive train systems, hydraulic systems, and diesel fuel systems.

8. Due to the large dependency on self developed material, farm power instructors should be given course work in instructional material development at the undergraduate level.

9. Intern programs should be developed to provide students the opportunity of working in the farm power field. These programs should be in conjunction with formal instruction.

Further research should be conducted to expand this study of secondary farm power instruction. From the writer's experiences, and from data collected in this study, the following recommendations for additional research are presented:

1. Additional study should be conducted to determine why a large percentage of farm power instructors have suspended their formal education at the bachelors level.

2. Additional study should be conducted to determine if problems other than instructional material exist within farm power instructional programs.
3. A further study is recommended to evaluate the adequacy of training received by students enrolled in secondary farm power instructional programs.
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APPENDICES
APPENDIX A
DISTRIBUTOR SERVICE

S. B. LANGHAM

DEPARTMENT OF AGRICULTURAL EDUCATION
SCHOOL OF VOCATIONAL EDUCATION
COLLEGE OF AGRICULTURE
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LOUISIANA
JANUARY, 1977
The job you are about to do is a very simple one. As the picture above shows you are going to remove and replace two main items. As you remove and replace these and other parts you must follow directions carefully.

You should have no trouble doing this task. It is a job that is done thousands of times a day in garages throughout the world. If you should have trouble or do not understand a step don't hesitate to ask your instructor for help.
TO PERFORM THIS TASK YOU WILL NEED TO LOCATE THE FOLLOWING TOOLS AND EQUIPMENT:

- SCREWDRIVER
- SMALL WRENCH SET
- FEELER GAUGE
- OIL CAN
- MASKING TAPE
DISTRIBUTOR CAM LUBRICANT

SOLVENT

SHOP RAG

MAGNETIC SCREW STARTER

SERVICE MANUAL
LOCATE THE DISTRIBUTOR.

MOST WILL BE ON THE SIDE OF THE ENGINE.

SOME MAY BE IN A HORIZONTAL POSITION.

SOME EARLY FORD MODELS WILL BE AT THE FRONT OF THE ENGINE.

WRAP MASKING TAPE AROUND THE PLUG WIRES, AND NUMBER THEM—
ENGINE CYLINDERS ARE NUMBERED IN ORDER, START AT THE FRONT OF THE ENGINE (FAN) AND GO TO THE BACK.

FOR V-8 ENGINES SEE A SERVICE MANUAL.

FOLLOW EACH PLUG WIRE TO THE DISTRIBUTOR AND PLACE A SMALL PIECE OF TAPE AT THE POLE. MARK THE SAME NUMBER AS YOU PLACED ON THE PLUG WIRE.

WITH A SCREWDRIVER REMOVE THE CLIPS HOLDING THE DISTRIBUTOR CAP.

GRASP THE PLUG WIRES BY THE BOOT AND REMOVE THEM.
REMOVE THE WIRES FROM THE DISTRIBUTOR.

LIFT THE DISTRIBUTOR CAP OFF THE DISTRIBUTOR.

TAKE A CLEAN RAG, DAMPEN WITH SOLVENT, AND CLEAN THE DISTRIBUTOR.
EXAMINE THE DISTRIBUTOR CAP.
REPLACE IF YOU FIND:
- BROKEN OR CHIPPED
- CRACKED
- CARBON TRACK
- BURNED TERMINAL

GRASP THE ROTOR CAP
AND PULL UP.

TAKE A CLEAN RAG, DAMPEN WITH
SOLVENT, AND CLEAN THE ROTOR CAP.

EXAMINE THE ROTOR CAP.
REPLACE IF YOU FIND:
- WORN CONTACT
- CORRODED TIP
- CRACKED
DO NOT SCRAPE OR CLEAN THE ROTOR TIP!

THE CLEARANCE BETWEEN THE ROTOR TIP AND THE DISTRIBUTOR CAP IS CRITICAL.

TO WIDEN THE GAP WILL CAUSE BURNING AND POOR ENGINE PERFORMANCE.

MOST POINTS ARE HELD IN PLACE BY TWO SCREWS. WITH A SCREWDRIVER LOOSEN ONE SCREW--

--BEFORE THE SCREW COMES OUT, PLACE THE MAGNETIC END OF THE SCREW STARTER ON IT.
REMOVE THE SCREW WITH THE MAGNET.

UNSCREW THE OTHER SCREW--

--REMOVE THE SCREW WITH THE MAGNET AS THE SCREW COMES OUT.

REMOVE THE POINTS FROM THE DISTRIBUTOR.

NOTE: THE WIRES ARE STILL ATTACHED.
WITH A SMALL WRENCH LOOSEN THE NUT HOLDING THE WIRES.

REMOVE THE WIRES.

SPREAD THE POINTS AND EXAMINE THEM.
THIS IS NORMAL WEAR. YOU DO NOT HAVE TO REPLACE THE CONDENSER IF THIS CONDITION IS FOUND.

THIS IS BURNED. ALWAYS REPLACE THE CONDENSER IF THIS CONDITION IS FOUND.

THIS IS METAL TRANSFER. ALWAYS REPLACE THE CONDENSER IF THIS CONDITION IS FOUND.

IF THE POINTS SHOW NORMAL WEAR IT MEANS THAT THE CONDENSER IS GOOD. A GOOD CONDENSER VERY SELDOM WEARS OUT OR HAS TO BE REPLACED.

IF YOU DECIDE TO REPLACE THE CONDENSER UNSCREW THE RETAINING SCREW.
BEFORE THE SCREW COMES OUT--

--CATCH IT WITH THE MAGNET AND REMOVE IT.

LIFT OUT THE CONDENSER,

TEST THE MECHANICAL ADVANCE BY TURNING THE DISTRIBUTOR SHAFT IN THE DIRECTION IT NORMALLY ROTATES. IF IT IS GOOD IT WILL SNAP BACK ON RELEASE.
TO DETERMINE THE DIRECTION THE SHAFT NORMALLY ROTATES, CRANK THE ENGINE AND OBSERVE THE SHAFT.

PLACE A FEW DROPS OF OIL ON THE FELT PAD INSIDE THE DISTRIBUTOR SHAFT.

IF THE DISTRIBUTOR HAS OUTSIDE MEANS TO OIL IT, DO SO.
SOME MAY HAVE A PLUG.

SOME MAY HAVE AN OIL CAP.
Some may have a screw-in grease fitting.

Place a small amount of cam lubricant on the distributor shaft.

When replacing the condenser, note the mounting pattern.

---Note the matching pattern in the distributor.
PLACE THE CONDENSER IN THE DISTRIBUTOR.

LOAD THE SCREW ON THE SCREW STARTER.

START THE SCREW WITH THE SCREW STARTER.

TIGHTEN THE SCREW USING A SCREWDRIVER.
REPLACE THE WIRES GOING TO THE POINTS.

TIGHTEN THE BOLT HOLDING THE WIRES WITH A SMALL WRENCH.

NOTE THE MOUNTING PATTERN OF THE POINTS--

--NOTE THE MATCHING PATTERN IN THE DISTRIBUTOR.
PLACE THE POINTS IN THE DISTRIBUTOR.

START THE HOLDING SCREW USING THE SCREW STARTER.

TIGHTEN TO A SNUG FIT BUT NOT TOO TIGHT -- YOU MUST STILL ADJUST THE POINT GAP.

START THE SECOND HOLDING SCREW USING THE SCREW STARTER. IF IT HAS A GROUNDING STRAP MAKE SURE IT IS IN PLACE.
CRANK THE ENGINE UNTIL--

--THE POINTS ARE IN THIS POSITION.

CONSULT THE SERVICE MANUAL FOR THE PROPER POINT SETTING.

TIGHTEN SNUG.
FIND THE PROPER FEELER GAUGE.

ADJUST THE POINTS UNTIL THE FEELER GAUGE SLIDES INTO THE POINT GAP IN A SNUG FIT.

TIGHTEN ALL SCREWS HOLDING THE POINTS.

CHECK TO SEE THAT NO WIRES ARE RUBBING THE DISTRIBUTOR SHAFT.

REPLACE THE ROTOR CAP.
REPLACE THE DISTRIBUTOR CAP.

MATCH THE NUMBERS ON THE PLUG WIRES AND THE DISTRIBUTOR AND PLACE THE WIRES ON. MAKE SURE THE METAL ENDS ON THE PLUG WIRES GOES TO THE BOTTOM OF THE CUPS.

SNAP THE FASTENERS ON THE DISTRIBUTOR CAP.
ENGINE TIMING

S. B. LANGHAM

DEPARTMENT OF AGRICULTURAL EDUCATION
SCHOOL OF VOCATIONAL EDUCATION
COLLEGE OF AGRICULTURE
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LOUISIANA
FEBRUARY, 1977
TIMING AN ENGINE IS ONE OF THE MOST IMPORTANT PHASES OF A TUNE-UP. THE TIMING MUST BE SET TO ALLOW CURRENT TO THE PROPER SPARK PLUG AT THE EXACT TIME IT IS NEEDED.

THIS TASK IS A VERY SIMPLE ONE. YOU WILL NOT REPLACE ANY PARTS, YOU WILL MAKE A SIMPLE ADJUSTMENT USING THE PROPER EQUIPMENT. IF YOU SHOULD HAVE TROUBLE OR DO NOT UNDERSTAND A STEP DO NOT HESITATE TO ASK YOUR INSTRUCTOR FOR HELP.
TO PERFORM THIS TASK YOU WILL NEED TO
LOCATE THE FOLLOWING TOOLS AND EQUIPMENT:

TIMING LIGHT

TACHOMETER

COMBINATION BOX OPEN-END WRENCH

CHALK
LOCATE THE DISTRIBUTOR AND THE NUMBER ONE CYLINDER ON THE ENGINE.

ENGINE CYLINDERS ARE NUMBERED IN ORDER STARTING AT THE FRONT OF THE ENGINE (FAN) AND GOING TO THE REAR. NUMBER ONE CYLINDER WILL BE THE ONE CLOSE TO THE FAN.

FOR V-8 ENGINES SEE A SERVICE MANUAL.

CONNECT THE TIMING LIGHT ACCORDING TO THE MANUFACTURER'S DIRECTIONS.

USUALLY TWO WIRES WILL BE CONNECTED TO THE BATTERY AND ONE WIRE TO THE NUMBER ONE SPARK PLUG.
IF THE ENGINE YOU ARE WORKING ON HAS A VACUUM ADVANCE REMOVE THE HOSE AND PLUG IT WITH A PENCIL.

LOOSEN THE BOLT HOLDING THE DISTRIBUTOR IN PLACE.

CRANK THE ENGINE.

POINT THE TIMING LIGHT DIRECTLY AT THE TIMING MARKS.
CONSULT THE SERVICE MANUAL FOR THE FOLLOWING:
1. DEGREE OF TIMING
2. ENGINE RPM NECESSARY TO SET THE TIMING.

WITH A PIECE OF CHALK MARK OVER THE TIMING MARK STATED IN THE SERVICE MANUAL.

CONNECT THE TACHOMETER ACCORDING TO THE MANUFACTURER'S DIRECTIONS.

START THE ENGINE.

SET THE ENGINE IDLE TO THE SPEED STATED IN THE SERVICE MANUAL.

AFTER SETTING THE IDLE STOP THE ENGINE.
If the engine you are working on has a vacuum advance, remove the hose and plug it with a pencil.

Loosen the bolt holding the distributor in place.

Start the engine.

Point the timing light directly at the timing marks.
ROTATE THE DISTRIBUTOR UNTIL--

--THE CORRECT TIMING IS ACHIEVED.

TIGHTEN THE BOLT HOLDING THE DISTRIBUTOR.

IF THE ENGINE HAS A VACUUM ADVANCE REPLACE THE HOSE.
SPARK PLUG REPLACEMENT

S. B. LANGHAM

DEPARTMENT OF AGRICULTURAL EDUCATION
SCHOOL OF VOCATIONAL EDUCATION
COLLEGE OF AGRICULTURE
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LOUISIANA
JANUARY, 1977
THE JOB YOU ARE ABOUT TO DO IS A VERY IMPORTANT ONE. SPARK PLUG REPLACEMENT IS A SIMPLE TASK THAT TAKES VERY LITTLE TIME. THE RESULTS OF YOUR WORK WILL BE IMPROVED ENGINE PERFORMANCE AND FUEL ECONOMY.

YOU SHOULD HAVE NO TROUBLE DOING THIS TASK. IF YOU SHOULD HAVE TROUBLE OR DO NOT UNDERSTAND A STEP DON'T HESITATE TO ASK YOUR INSTRUCTOR FOR HELP.
TO PERFORM THIS TASK YOU WILL NEED TO
LOCATE THE FOLLOWING TOOLS AND EQUIPMENT:

RATCHET WRENCH

EXTENSION

SPARK PLUG SOCKET

SHOP AIR SUPPLY

OR

SODA STRAW

SPARK PLUG SERVICE TOOL
LOCATE THE SPARK PLUGS ON THE ENGINE.

GRASP THE BOOT OF THE PLUG WIRE AND PULL IT OFF THE SPARK PLUG.

NEVER PULL ON THE WIRE ITSELF. TO DO SO MAY DAMAGE THE WIRE.

WITH A SODA STRAW OR SHOP AIR SUPPLY BLOW THE TRASH FROM THE SPARK PLUG RECESS.
PLACE THE EXTENSION ON THE SOCKET WRENCH; THE SPARK PLUG WRENCH ON THE EXTENSION; REMOVE THE SPARK PLUG BY TURNING COUNTER CLOCKWISE.

LIFT THE SPARK PLUG FROM THE HOLE.

CONSULT THE SERVICE MANUAL FOR THE FOLLOWING:
1. SPARK PLUG TYPE
2. SPARK PLUG GAP SETTING

USING THE SPARK PLUG TOOL MEASURE THE GAP DISTANCE.

USING THE SPARK PLUG TOOL, ADJUST THE SPARK PLUG GAP TO THE SERVICE MANUAL SPECIFICATIONS.
IF THE SPARK PLUG HAS A METAL GASKET, PUT IT ON.

START THE SPARK PLUG BY HAND, TIGHTEN BY HAND UNTIL IT WILL TURN NO MORE.

WITH THE SPARK PLUG WRENCH, SOCKET WRENCH AND EXTENSION, TIGHTEN THE SPARK PLUG TO A VERY SNUG FIT. DO NOT OVER TIGHTEN!

REPLACE THE PLUG WIRES BY THE PLUG WIRE BOOT.
The Agricultural Education Department at Louisiana State University is currently developing instructional materials in the area of farm power machinery. You could be of considerable assistance to us by supplying the names and addresses of persons in your state now teaching this subject on the high school level. We plan to send selected teachers copies of our material for their evaluation and suggestions.

Thank you for your cooperation.

Sincerely yours,

S. B. Langham
Vocational Agricultural Education Department
Louisiana State University
APPENDIX C
The Agricultural Education Department at Louisiana State University is currently developing instructional material in the area of Farm Power Machinery. To help us with our task we are asking successful teachers to evaluate current material and review new material being developed.

Your name was given to us by your State Director of Vocational Agriculture. He felt you maintained an outstanding Farm Power program and would be willing to assist us.

I have included a questionnaire for you to evaluate current material and to give us an in-sight to the training that you have received.

If you will complete the questionnaire and return it in the stamped self-addressed envelope I would be most grateful.

Sincerely yours,

S. B. Langham
Department of Agricultural Education

SBL: mkm
Enclosures
APPENDIX D
Teacher's Name* ________________________________

School District* ________________________________

* To be discarded after a number has been assigned.

Teaching experience:

Years teaching ________

Years teaching Vo. Ag. ________

Years teaching farm power ________

Years in present school system_______

Educational level:

Bachelor's Degree ________

Working on Master's Degree ________

Master's Degree ________

Higher Degree (please list)___________________________________________

Type of farm power program you teach:

Agri-Lab training Number of students______

Cooperative training Number of students______

Adult education Number of students______

Check the extent of use for each of the following references if now used in your farm power instructional program:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Great Extent</th>
<th>Moderate Extent</th>
<th>Some Extent</th>
<th>No Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>State adopted textbook</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.A.V.I.M. material</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State developed material</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Company developed material</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personally developed material</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Your experience and training in farm power or a related field:

Home shop training  __Yes __No

High school Vo.Ag. training  __Yes __No  Number of years__

Vocational trade school  __Yes __No  Number of years__

College  __Yes __No  Credit hours__

Military  __Yes __No  Number of years__

Employment in industry  __Yes __No  Number of years__

Inservice training  __Yes __No  Number of courses__

Check the adequacy of training you feel you have received in the following areas:

<table>
<thead>
<tr>
<th>Area</th>
<th>Very Adequate</th>
<th>Adequate</th>
<th>Limited</th>
<th>No Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop orientation (safety, etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of engine operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhaul of major engine components</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel fuel systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulic systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive train systems</td>
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</table>

Please make any suggestions or recommendations to help us prepare teaching materials for your needs.
To what extent do the instructional materials you are now using meet your program needs?

<table>
<thead>
<tr>
<th>Item</th>
<th>Very adequate</th>
<th>Adequate</th>
<th>Inadequate</th>
<th>Very inadequate</th>
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<tbody>
<tr>
<td>Amount of material content for teaching farm power at high school level</td>
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<tr>
<td>Content development</td>
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<tr>
<td>Understanding stressed in material</td>
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<tr>
<td>Material in appropriate sized units</td>
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<tr>
<td>Reading level based on student ability</td>
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<td>Material presented on high school student level</td>
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<td>Material presented in a challenging way</td>
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<tr>
<td>Illustrations sufficient to meet your and student needs</td>
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<td>Illustrations compatible and they reinforce the script</td>
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<tr>
<td>Illustrations clear and understandable</td>
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<tr>
<td>Material clearly identifies major points</td>
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<tr>
<td>Material content up-to-date</td>
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<tr>
<td>Material free of confusing or conflicting concepts</td>
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<tr>
<td>Materials meet instructional needs</td>
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Would you be willing to review and evaluate our instructional material if a complementary copy were sent to you?

_____ Yes.    _____ No.
You stated in the returned questionnaire that you are willing to review instructional materials that we are developing in Farm Power. After reviewing your educational background and the recommendation of your state supervisor, we have selected you to help us in this task. You are one of fifty teachers we feel will best represent farm power instructors throughout the nation.

Enclosed you will find three units that have been developed: Distributor Service, Spark Plug Replacement, and Engine Timing. Please review these carefully and give us your opinions on the enclosed questionnaire. These units are yours to keep for use in your program.

Thank you for your cooperation and professional attention to this matter.

Sincerely,

S. B. Langham
Agricultural Education

SBL: ada
Enclosure
Teacher's Name*:___________________________________________________
School District*:__________________________________________________
*To be discarded after a number has been assigned.

Do you feel there is a need for material developed in this style?
____Yes
____No

Your overall rating of material.
____Superior
____Good
____Fair
____Poor

Would you like to see more material developed in farm power machinery using this same style?
____Yes
____No

How would you prefer the material bound.
____Loose-leaf notebook
____Soft cover
____Hard back
____Spiral binding

How would you prefer the material presented.
____Individual units. (Each bound separately)
____All units bound in one copy.
____Similar topics bound together.

How many copies of this material do you feel would be most effective in your program?
____One (1) copy per student.
____One (1) copy per 2 students.
____One (1) copy per 3 to 5 students.
____Less. How many students per copy?____

How do you feel this material could best be used?
____For classroom teaching to an entire class
____For classroom teaching to a small group
____For classroom teaching to individuals
____For individual use in the shop while performing the task.
Please rate the extent you feel these instructional materials will meet your program needs.

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<tr>
<th></th>
<th>Very adequate</th>
<th>Adequate</th>
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<th>Very inadequate</th>
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<tr>
<td>1. Content development</td>
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<td>2. Understanding stressed in material</td>
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<tr>
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</table>

Of the above which do you feel are the materials strong points? #   #

Of the above which do you feel are the materials weak points? #   #
Please compare these materials with instructional materials you are now using.

Rating scale for developed materials:

<table>
<thead>
<tr>
<th>Far Superior</th>
<th>Superior</th>
<th>Same</th>
<th>Inferior</th>
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Developed Materials

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<tr>
<th>State adopted textbook</th>
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<tr>
<td>FS</td>
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<td>Same</td>
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<th>A.A.V.I.M.</th>
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<tr>
<th>State developed material</th>
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<td>FS</td>
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<tr>
<th>Company developed material</th>
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<tbody>
<tr>
<td>FS</td>
<td>S</td>
<td>Same</td>
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<tr>
<th>Personally developed material</th>
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<tr>
<td>FS</td>
<td>S</td>
<td>Same</td>
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</table>

What changes would you recommend in materials reviewed?

________________________________________________________________________

List areas of farm power in which similar instructional materials should be developed. (List in order of importance)

________________________________________________________________________

________________________________________________________________________

Please list any technical errors found:

Distributor service:__________________________________________________________

________________________________________________________________________

Spark plug replacement:_______________________________________________________

________________________________________________________________________

Engine Timing:_______________________________________________________________

________________________________________________________________________
APPENDIX F
DRAW A CIRCLE AROUND THE DISTRIBUTOR ON THIS ENGINE

THIS PART IS THE:
A. COIL
B. CONDENSER
C. POINTS
D. ROTOR

IF A SPARK PLUG HAS A METAL GASKET:
A. PUT IT ON
B. DO NOT PUT IT ON
C. MEASURE THE GAP
D. ADJUST THE GAP
WHEN THE POINTS ARE IN THIS POSITION THEY ARE:

A. OPEN
B. CLOSED
C. OPENING
D. CLOSING

NUMBER ONE CYLINDER IS:

A. ___  C. ___
B. ___  D. ___

THIS TOOL IS A:

A. SMALL TOOL FILE
B. SPARK PLUG SERVICE TOOL
C. POINT SETTER
D. POINT SERVICE TOOL

THE TASK BEING PERFORMED IS:

A. ADJUSTING POINTS
B. ADJUSTING A SPARK PLUG GAP
C. MEASURING THE SPARK PLUG GAP
D. TESTING A SPARK PLUG
TOP DEAD CENTER IS MARKED BY:

A. 0  
B. 3  
C. 6  
D. THE NOTCH IN THE WHEEL POINTING TO THE NUMBER ONE CYLINDER

THIS PIECE IS CALLED:

A. THE DISTRIBUTOR CAP  
B. THE ADVANCER  
C. THE ROTOR CAP  
D. INSIDE WHEEL

THE TASK BEING PERFORMED IS:

A. LOADING A SCREW STARTER  
B. MEASURING THE SCREW SIZE  
C. CLEANING THE SCREW HEAD  
D. NONE OF THE ABOVE

THESE POINTS ARE BURNED YOU SHOULD:

A. REPLACE THE CONDENSER  
B. NOT REPLACE THE CONDENSER  
C. CLEAN THE CONDENSER  
D. USE A LARGER CONDENSER
THE TIMING LIGHT IS USED TO:

A. TIME THE OPENING AND CLOSING OF THE POINTS
B. TO GIVE LIGHT IN DARK PLACES
C. ADJUST THE POINTS
D. HEAT THE POINTS

WHEN SHOULD THE CONDENSER BE REPLACED:

A. EVERY TIME THE POINTS ARE REPLACED
B. EVERY SECOND TIME THE POINTS ARE REPLACED
C. ONLY IF THE POINTS SHOW UNUSUAL WEAR
D. NEVER

DO YOU EVER OIL A DISTRIBUTOR?

A. YES
B. NO
C. ONLY WITH O.S.H.A. OIL
D. ONLY ON LP-GAS TRACTORS

ALWAYS START A SPARK PLUG IN TO THE HOLE BY USING:

A. A SPARK PLUG WRENCH
B. YOUR HAND
C. OPEN END WRENCH
D. A TORQUE WRENCH

THE BEST WAY TO MEASURE THE GAP IN A SPARK PLUG IS TO USE:

A. A THIN DIME
B. A SPARK PLUG SERVICE TOOL
C. ALL NEW PLUGS ARE PRE-SET AND THERE IS NO NEED TO MEASURE THEM
D. ALL OF THE ABOVE

WHEN YOU TIGHTEN SPARK PLUGS:

A. DO NOT OVER TIGHTEN
B. PUT AS TIGHT AS YOU CAN
C. PUT THEM HAND TIGHT
C. TIGHTEN THEM TILL THEY MAKE A SQUEEZE NOISE
TO SERVICE A ROTOR TIP:

A. FILE THE TIP  
B. SCRAPE THE TIP WITH A KNIFE  
C. DO NOTHING TO THE TIP  
D. BRUSH THE TIP WITH A WIRE BRUSH

THE BEST WAY TO START A SCREW IS BY USING:

A. YOUR HAND  
B. A SCREW STARTER  
C. A SCREWDRIVER  
D. A MAGNET

TO SET THE TIMING ON AN ENGINE THE FOLLOWING IS ADJUSTED:

A. THE POINTS  
B. THE CONDENSER  
C. THE DISTRIBUTOR  
D. THE SPARK PLUGS

A TIMING LIGHT IS USUALLY ATTACHED TO WHICH SPARK PLUG:

A. THE ONE NEAR THE KEY  
B. THE NUMBER ONE SPARK PLUG  
C. THE LAST SPARK PLUG ON AN ENGINE  
D. ANY SPARK PLUG

TIMING MARKS ARE USED TO:

A. SET THE POINTS  
B. SET THE ENGINE TIMING  
C. ADJUST THE CARBURETOR  
D. SET THE TIMING OF THE CRANKSHAFT
ALWAYS REMOVE THE SPARK PLUG WIRES BY:

A. PULLING ON THE WIRE
B. PULLING ON THE PLUG WIRE BOOT
C. REMOVING THE SPARK PLUG
D. USING A PAIR OF PLIERS

ALWAYS REPLACE THE ROTOR CAP IF YOU FIND:

A. WORN CONTACT
B. CORRODED TIP
C. CRACKED BODY
D. ALL THE ABOVE
Descriptors

Agricultural Mechanics (Subject)
Agricultural Mechanics (Occupation)
Mechanics
Agricultural Machinery
Equipment Maintenance
Farm Mechanics
Farm Mechanization
Tractors
Engines
Farm Power and Machinery
Job Analysis
Job Skills
Job Training
Evaluation Techniques
Evaluation Methods
Instructional Materials
Instructional Evaluation
Task Inventory Exchange  
The Center for Vocational Education  
The Ohio State University  
1960 Kenny Road  
Columbus, OH 43210

Gentlemen:

I am researching available literature to construct a list of skills necessary for the tune-up of gasoline power units. You would be of considerable assistance to me if you could provide information about materials you have developed in this area. Specifically the areas in which I am interested are:

- Farm power and machinery  
- Tractors  
- Gasoline engine tune-up  
- Gasoline engines

I would appreciate any help you can give.

Sincerely,

S. B. Langham  
Department of Agricultural Education
APPENDIX I
INSTRUCTOR SUGGESTIONS FOR THE DEVELOPMENT
OF NEW INSTRUCTIONAL MATERIALS

The primary goal is to give theory and basic concepts to interest the student in further training and/or practice to start in the trade.

Keep your material practical, readable, and interesting to the students. A lot of materials have too much theory and go too deep. Build more skill type work into materials. Hands-on training keeps students interested and meets their needs and demands.

Keep the reading level at a 5th or 6th grade level. Break the units down into sub-units or modules with a variety of activities.

Most material we get is too detailed and the total unit cannot be covered in the prescribed time to allow time for other material and shop experience. Teach basic principles. Details can be found in the service manuals.

I think it is important to reinforce classroom theory immediately with hands-on training or by the demonstration method with cut-a-ways or audio-visuals. Classroom materials should relate directly to lab assignments.

Make them up-to-date. We need more than tractors, for example pickups and combines.

Our program is very broad and has been developed around our operating farm of approximately eighty acres. This operation consists of cropland in support of a small beef herd of twenty brood cows and feeder steers and a feeder pig operation. In addition we own and maintain all of our own farm equipment. Although I have found abundant material available for the power equipment program, it takes more time than is available under our current curriculum set-up. I feel the majority of materials are aimed at specific trades, such as auto mechanics, diesel mechanics, etc. as utilized in a Vo. Tech. high school. I am interested in material arranged in short units or packages, which are useful and meaningful to the high school Vo. Ag. student, with specific emphasis on the 9th and 10th grade levels where time is most limited and foundation materials are most essential.

Single concept films seem to do a good job for students and adults. The reading comprehension of our students has declined considerably!

Materials clearly illustrated and easily understood by students would be of value.

In Vo. Ag. we need more materials on farm tractors and machinery rather than so much devoted to small gas engines. This would be more in line with the interests of high school seniors.
Some complete units on machinery maintenance and basic machine care would be helpful.

I feel that the development of materials for students with low level reading ability would be of great use. A separate set of special study guides which could be used as a supplement to a text would be helpful. It should include simple definitions and more exact explanations which could be used by remedial reading instructors to help students.

Need electrical and hydraulic materials.

Need good text on current job markets in Ag. Mec. service. Student needs to know more about types of jobs available and what entry-level skills and knowledge are needed to obtain those jobs.

Make a teachers copy with theory and background; up-to-date comparisons of different types of a component; the date (year), name brand, and model that the component will be used on. Also, a list of references and technical manuals available for further study and information.

Specific tolerances of wear to determine when to replace parts. (Example: valve stem to guide, wrist pin bushing.) These are not always in the I & T manuals.

Give us basic pictures and descriptions and perhaps miniature models to use and display.

Transparencies are excellent. I break my instruction down into units such as "spark plugs" or "batteries". This way materials broken down into units will illustrative diagrams, pictures, etc. are helpful.

We need references and teaching materials on farm machinery and equipment. My supply is limited and the commercial material on equipment is too expensive.

We should have opportunities to go to implement manufacturers plants for in-service schools as do special mechanics for the auto industry. Maybe on-the-job opportunities for college credits. Educational tours of those plants too. Cost could be paid or shared by manufacturers and school districts.

Individual student packets for each of the major divisions of farm power, hydraulics, power train, etc. (Colorful illustrations)

Yearly in-service training sessions presented by industry on the level of the student. Service manuals by I & T publications are not always clear for students. Need service manual from manufacturer including parts manual. Class room teaching books such as our state agricultural machinery book is good. Need more shop repair manuals.

Details make the difference.

Teachers, themselves, need more hands-on experience. I expect to attend
diesel pump or similar school this summer. Our school's in-service courses
are generally too general and not specific enough.

I like to work on actual units with my students. More reference materials
to the units we are using would be helpful for the students.

Things that are helpful to me in prepared units are: masters for the
overhead projector, a simple format of a teaching unit, etc. Too many lessons
get lost in objectives, methods, evaluation and forget to put down the
necessary information to give the students. Use current references that are
up to date and available at a small cost to the departments. Industry has
some excellent sources if you can find out how to get them.

Agricultural mechanization teachers need more training in general machine
maintenance. It must be a hands-on basic taught by an experienced mechanic,
actively involved in the field of agricultural mechanization.

My teaching is "competency based" with little lecture involved. I use
personally developed packets of individual learning materials called
"modules". I use textbooks, state guidelines, and industry materials for
references in my modules which are designed to assist students in gaining
"job entry level" skills, primarily in the students local geographic area.

Make the materials specific rather than general.

In the production of visual aids I find slides & transparencies much more
useful than film or filmstrips. Suggestion of hands-on exercises for teaching
units might be most helpful to those starting out in this area. Appropriately
sized units is a very important aspect.
VITA

Seburn B. Langham, Jr. was the youngest son of Bettie Irene Langham and Seburn B. Langham, Sr. He was born October 13, 1945, in Jefferson County, Texas.

He received his elementary and secondary education at Nederland Public School, Nederland, Texas, and was graduated in May, 1964. In September, 1964 he entered Sam Houston State University. He was awarded a Bachelor of Science Degree and Texas teaching certificate in vocational agriculture education in May, 1969.

He married the former Judy Gail Janecke in July, 1969. To this couple was born one child, a daughter, Julia Irene Langham, November, 1974.

From July, 1969 until June, 1971 he served as teacher of vocational agriculture in the Spring Independent School System, Spring, Texas. During this period he attended Sam Houston State University at night in order to pursue graduate study.

In July, 1971 he accepted a position in the Neches Independent School System, Neches, Texas, as a teacher of vocational agriculture in the field of tractor mechanics. He continued to attend night courses at Sam Houston State University and received a Master of Education in vocational agricultural education in August, 1973.

In May, 1974 he entered private industry as a service manager in the farm machinery field. He supervised the service department of the second largest Case tractor dealership in the world.
The investigator accepted a graduate assistantship in vocational agricultural education from Louisiana State University in January, 1975. He is presently engaged in that activity while in pursuit of a Ph.D. degree in vocational agricultural education with minor work in agricultural mechanization.
EXAMINATION AND THESIS REPORT

Candidate:  Seburn Bluite Langham

Major Field:  Vocational Agricultural Education

Title of Thesis: The Development and Evaluation of Instructional Material in Farm Power Machinery

Approved:

[Signature]
Major Professor and Chairman

[Signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signature]

[Signature]

[Signature]

Date of Examination:

July 6, 1977