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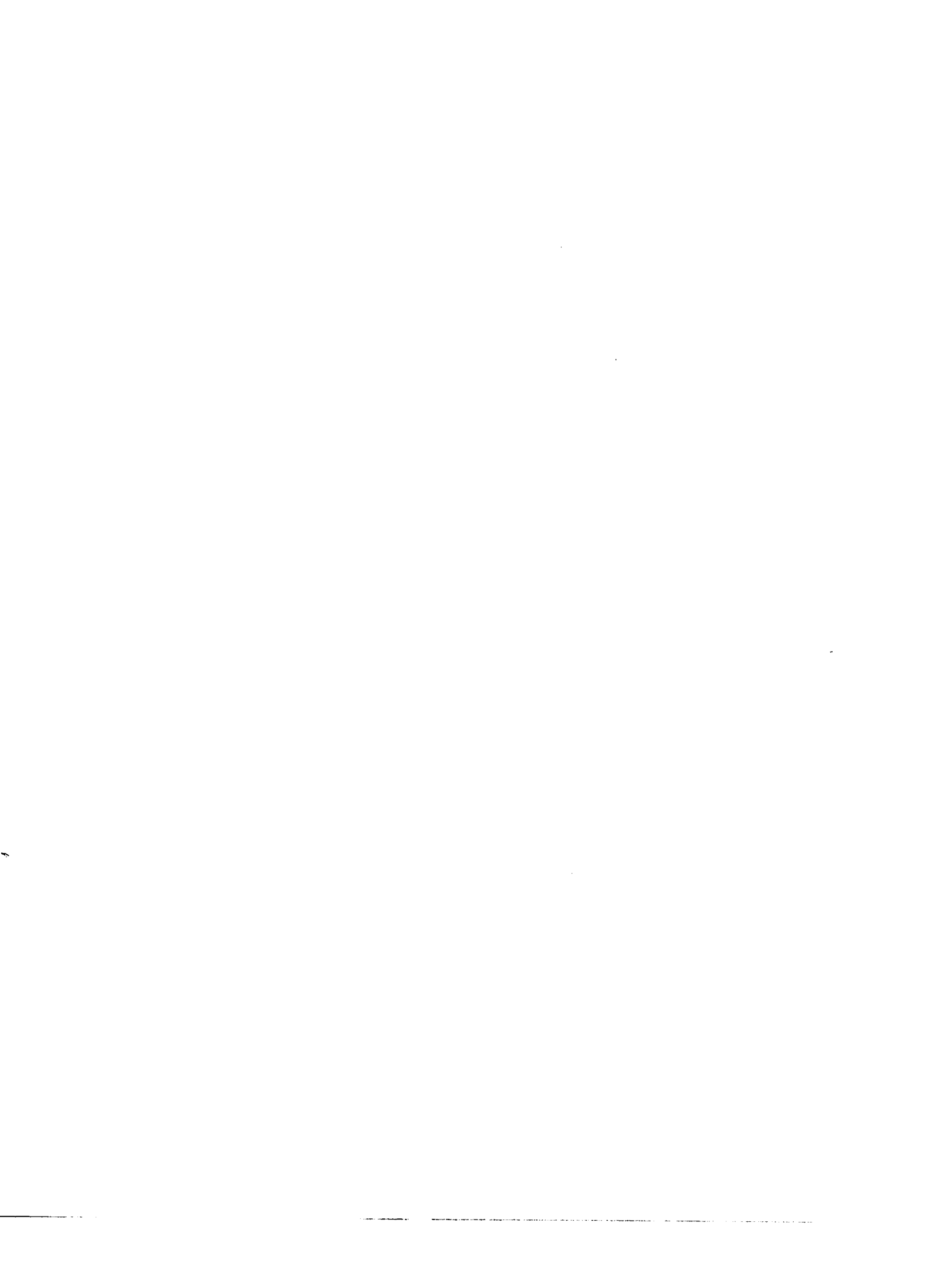
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**Effects of approach to teaching on student achievement,  
retention, and attitude**

Boone, Harry Nelson, Jr., Ph.D.

The Ohio State University, 1988

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300 N. Zeeb Rd.  
Ann Arbor, MI 48106



EFFECTS OF APPROACH TO TEACHING ON STUDENT  
ACHIEVEMENT, RETENTION, AND ATTITUDE

DISSERTATION

Presented in Partial Fullfillment of the Requirements  
for the Degree Doctor of Philosophy in the Graduate  
School of The Ohio State University

By

Harry Nelson Boone Jr., B.S., M.S.

\*\*\*\*\*

The Ohio State University

1988

Dissertation Committee: Approved By

Dr. L. H. Newcomb



Advisor

Department of Agricultural  
Education

Dr. J. Robert Warmbrod

Dr. Janet Henderson

Dr. Lowell Hedges

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## DEDICATION

Many times in life a decision, that is clear and logical to us, is never quite understood by the ones we love. Graduate school and the Doctoral program at The Ohio State University was one such decision for this writer.

Even though they may not have fully understood what went into the decision to attend graduate school, my parents and sister were behind me one hundred percent with their love and support. For this I will be eternally grateful. Thank you Harry, Violet, and Virginia for your love and support for my decision.

Sometimes our decisions and actions seem to come together like pieces of a master plan. I am a firm believer that God watches over us and guides our lives. His master plan brought two such lives together at The Ohio State University. To my lovely wife, Debby, with whom I will share this degree, thank you for your love, patience, support, and understanding. Without you, this accomplishment would not be the same.

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## VITA

August 20, 1955    Born: Frankford, West Virginia

1973                Graduated Greenbrier East High  
School, Lewisburg, West Virginia

1977                Bachelor of Science  
Agricultural Education  
West Virginia University  
Morgantown, West Virginia

1977-1986          Vocational Agricultural Instructor  
Greenbrier County Schools  
Greenbrier East High School  
Lewisburg, West Virginia

1982                Master of Science  
Agricultural Education  
West Virginia University  
Morgantown, West Virginia

1986-1988          Graduate Research Associate  
Department of Agricultural Education  
The Ohio State University  
Columbus, Ohio

## FIELDS OF STUDY

### Major Field: Agricultural Education

Agricultural Education	Dr. L. H. Newcomb Dr. J. Robert Warmbrod
Research and Statistics	Dr. R. Kirby Barrick
Teacher Education	Dr. Donald Cruickshank

## PUBLICATIONS AND PRESENTATIONS

### Refereed Journal Articles

Boone, H. N., Doerfert, D. L., and Elliot, J. F. (Winter, 1987). Supervised occupational experience programs: History, philosophy, current status, and future implications. Journal of the Association of Teacher Educators in Agriculture, 28 (4), 57-64.

### Refereed Presentations

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## TABLE OF CONTENTS

	Page
DEDICATION.....	ii
ACKNOWLEDGEMENTS.....	iii
VITA.....	v
LIST OF TABLES.....	x
LIST OF FIGURES.....	xiii
CHAPTER	
I. INTRODUCTION.....	1
Statement of the Problem.....	3
Objectives of the Study.....	4
Definition of Terms.....	5
Definitions.....	6
Limitations of the Study.....	7
II. REVIEW OF LITERATURE.....	8
The Problem Solving Approach in Teaching Method Text Books.....	8
Item Summary.....	15
The Problem Solving Approach in Agricultural Education Literature.....	16
Item Summary.....	20
Psychology of Problem Solving.....	21
Item Summary.....	34
Research on Problem Solving in Agriculture.....	35
Chapter Summary.....	39
III. METHODOLOGY.....	40
Research Design.....	41
Subject Selection.....	46
Internal and External Validity.....	48
Procedure.....	50
Instrumentation.....	51
Verification of Treatment.....	53
Data Collection.....	53
Data Analysis.....	54

	Page
IV. ANALYSIS AND INTERPRETATION OF DATA.....	55
Reliability of Instruments Used in the Study.....	56
Analysis of Teaching Performance Tapes.....	59
Attitudes Toward Instruction Approaches.....	64
Univariate Analysis of Achievement Data.....	70
Multivariate Analysis of Covariance Results.....	81
Multivariate Analysis of Covariance with Repeated Measures and Two Independent Variables.....	86
Instructional Time for Units.....	96
Summary.....	98
V. SUMMARY, CONCLUSIONS, DISCUSSION, and RECOMMENDATIONS.....	101
Purpose of the Study.....	101
Procedure.....	101
Summary of Findings and Conclusions...	102
Conclusions.....	105
Discussion.....	107
Recommendations.....	111

APPENDICES.....	113
A. Letter of Introduction.....	113
B. Reply Card.....	116
C. Letter of Participation in Study.....	118
D. Letters with Materials for Study.....	121
E. Teacher Log #1 AND Log #2.....	126
F. Follow-Up Letter: Return Postage.....	129
G. Follow-up Letter: Posttest Reminder.....	132
H. "Controlling Weeds in Corn": Problem Solving Approach Unit Plan.....	134
I. "Controlling Weeds in Corn": Subject Matter Approach Unit Plan.....	146
J. "Controlling Weeds in Corn": Handouts and Overhead Masters.....	156
K. "Controlling Weeds in Corn": Test Questions.....	167
L. "Controlling Weeds in Corn": Attitude instrument..	176
M. "Preparing Beef Cattle for Show:" Problem Solving Approach Unit Plan.....	180
N. "Preparing Beef Cattle for Show:" Subject Matter Approach Unit Plan.....	191
O. "Preparing Beef Cattle for Show:" Handouts and Overhead Masters.....	200
P. "Preparing Beef Cattle for Show:" Test Questions..	210
Q. "Preparing Beef cattle for Show:" Attitude Instrument.....	218
R. Problem Solving Approach to Teaching Unique Features.....	222
S. Evaluation of Teaching Approaches Instrument.....	228

LIST OF TABLES

Table	Page
1. Reliability of Instruments Used in the Study.....	59
2. Weighted Teaching Scores for Teachers Participating in the Study.....	61
3. Average Weighted Teaching Score for Teachers Completing the "Preparing Beef Cattle Show" Instructional Unit.....	62
4. Average Weighted Teaching Score for Teachers Completing the "Controlling Weeds in Corn" Instructional Unit.....	63
5. Average Attitude Toward Instruction Score of Students Who Received the "Preparing Beef Cattle for Show" Instructional Unit.....	65
6. Analysis of Variance Comparing Average Attitude Toward Instruction Scores of Students Who Received the "Preparing Beef Cattle for Show" Instructional Unit.....	66
7. Average Attitude Toward Instruction Score of Students Who Received the "Controlling Weeds in Corn" Instructional Unit.....	68
8. Analysis of Variance Comparing Average Attitude Toward Instruction Scores of Students Who Received the "Controlling Weeds in Corn" Instructional Unit.....	69
9. Average Pretest Scores of Students Completing the "Preparing Beef Cattle for Show" Instructional Unit.....	71
10. Average Pretest Scores of Students Completing the "Controlling Weeds in Corn" Instructional Unit.....	71
11. Average Posttest #1 Scores of Students Completing the "Preparing Beef Cattle for Show" Instructional Unit.....	72

Table	Page
12. Analysis of Variance Comparing Average Posttest #1 Scores of Students Completing the "Preparing Beef Cattle for Show" Instructional Unit.....	73
13. Average Posttest #2 Scores of Students Completing the "Preparing Beef Cattle for Show" Instructional Unit.....	75
14. Analysis of Variance Comparing Posttest #2 Scores of Students Completing the "Preparing Beef Cattle for Show" Instructional Unit.....	76
15. Average Posttest #1 Scores for Students Completing the "Controlling Weeds in Corn" Instructional Unit.....	78
16. Analysis of Covariance Comparing Average Posttest #1 Scores for Students Completing the "Controlling Weeds in Corn" Instructional Unit.....	79
17. Average Posttest #2 Scores for Students Completing the "Controlling Weeds in Corn" Instructional Unit.....	80
18. Analysis of Covariance Comparing Average Posttest #2 Scores for Students Completing the "Controlling Weeds in Corn" Instructional Unit.....	80
19. Average Pretest and Posttest Scores for Students Completing the "Preparing Beef Cattle for Show" Instructional Unit.....	83
20. Multivariate Analysis of Covariance Comparing Average Posttest Scores of Students Completing the "Preparing Beef Cattle for Show" Instructional Unit.....	84
21. Average Pretest and Posttest Scores of Students Completing the "Controlling Weeds in Corn" Instructional Unit.....	85
22. Multivariate Analysis of Covariance Comparing Average Posttest Scores of Students Completing the "Controlling Weeds in Corn" Instructional Unit.....	86



Table	Page
23. Adjusted Mean Posttest Scores for Students Completing the "Preparing Beef Cattle for Show" Unit of Instruction.....	88
24. Adjusted Mean Posttest Scores for Students Completing the "Controlling Weeds in Corn" Instructional Unit.....	89
25. Multivariate Analysis of Covariance with Repeated Measures Comparing Adjusted Student Scores on the "Preparing Beef Cattle for Show" Instructional Unit.....	91
26. Multivariate Analysis of Covariance with Repeated Measures Comparing Adjusted Student Scores on the "Controlling Weeds in Corn" Instructional Unit.....	95
27. Average Instructional Time Needed to Complete to Teach Units in "Preparing Beef Cattle for Show" and "Controlling Weeds in Corn" Using a Problem Solving and Subject Matter Approaches.....	97
28. Analysis of Variance Comparing the Average Instructional Time Needed to Teach the "Preparing Beef Cattle for Show" Instructional Unit.....	98
29. Analysis of Variance Comparing the Average Instructional Time Needed to Teach the "Controlling Weeds in Corn" Instructional Unit.....	98

## LIST OF FIGURES

FIGURE	Page
1. Counterbalance Design.....	45
2. Student's Attitude Toward Instruction Score for Students Who Received the "Preparing Beef Cattle for Show" Instructional Unit.....	67
3. Student's Attitude Toward Instruction Score for Students Who Received the "Controlling Weeds in Corn" Instructional Unit.....	70
4. Posttest #1 Scores for Students Who Completed the "Preparing Beef Cattle for Show" Instructional Unit.....	74
5. Posttest #2 Scores for Students Who Completed the "Preparing Beef Cattle for Show" Instructional Unit.....	77
6. Comparison of Differences Between Posttest for Students Completing the "Preparing Beef Cattle for Show" Instructional Unit.....	90
7. Comparisons of Adjusted Student Scores on the "Preparing Beef Cattle for Show" Instructional Unit.....	92
8. Comparison of Differences Between Posttest for Students Completing the "Controlling Weeds in Corn" Instructional Unit.....	94
9. Comparisons of Adjusted Student Scores on the "Controlling Weeds in Corn" Instructional Unit.....	96
10. Comparison of Adjusted Student Scores and Weighted Teaching Scores on the "Preparing Beef Cattle for Show" Instructional Unit.....	108

## CHAPTER I

### INTRODUCTION

Many people equate the learning process with schools, instruction, and teachers but people learn everyday without the help of formal instruction. What processes do people use as they face everyday problems, situations, questions, and obstacles?

If the processes which are used successfully by people in everyday situations can be isolated then could one not teach in a formal classroom using the same process? Would it not make sense for teachers to use the same processes in the classroom that students will generally follow as adults in the real world (Newcomb, McCracken, & Warmbrod, 1986)?

John Dewey, an educational philosopher, defined a scientific method of teaching which combined ideation with overt muscular acts. He concluded that the best kind of thinking included an overt doing. The act of thought began with a problem or a problematic situation and always ends in a clear situation (Broudy, 1965). Variations of the scientific method have been recommended by agricultural educators since the beginning of

agricultural education (Binkley and Tulloch, 1981; Crunkilton, and Krebs, 1982; Hammonds, 1950; Krebs, 1967; Lancelot, 1944; Newcomb, McCracken, and Warmbrod, 1986; and Stewart, 1950).

The problem solving approach has been widely accepted as the way to teach vocational agriculture and few critics have expressed any opposition to its effectiveness on student achievement. Proponents give numerous arguments for continued use of the problem solving approach in teaching vocational agriculture.

Newcomb (1974, 1976) stated the problem solving approach is a student centered way of teaching where the students are active participants in the learning process. The problem solving approach uses real problems that are more effective in developing a felt need to know in the students (Clover, 1953; Liggett, 1951; Newcomb, 1974; and Dickerson, 1984). Rosenfeld (1983) argued that students are taught to use the scientific method and not to simply follow procedures. The problem solving approach challenges students to develop thinking skills (Jones, 1986). Crunkilton (1985) felt that the problem solving approach not only helped students develop thinking skills but gave them experience in the transfer of the skills and knowledge learned in the classroom to other situations outside of the classroom.

From time to time the agricultural education profession must evaluate the teaching methods being used. Moore and Moore (1984) challenged the agricultural education profession to evaluate the problem solving approach, establish its effectiveness, or to look for alternate methods of instruction to be incorporated into the teaching of vocational agriculture.

Education has been criticized for its reliance upon "soft" research and traditions. To overcome this criticism, education must establish sound scientific evidence for the practices commonly used in teaching students. Agricultural education and the problem solving approach to teaching cannot be an exception. The effectiveness of the problem solving approach of teaching vocational agriculture, a) must be established and the profession continue to recommend its use, or b) proven ineffective and discarded or modified to meet the needs of vocational agriculture teachers and students.

#### STATEMENT OF THE PROBLEM

The problem investigated in this study was which approach, problem solving or subject matter, is the most effective in teaching high school vocational agriculture students as measured by which approach is best in providing for the student to exhibit higher levels of achievement test scores at the end of an instructional

unit?

The study was designed to determine if a problem solving approach or a subject matter approach was better in terms of student achievement, retention of learning, and attitude toward instruction.

#### OBJECTIVES OF THE STUDY

The objectives of this study are reflected by the following research questions:

1. Which approach to teaching (problem solving or subject matter) will result in higher student achievement on a given unit of instruction in vocational agriculture?
2. Will there be a difference in student retention of knowledge between students taught with a subject matter approach and students taught with a problem solving approach?
3. Which approach to teaching (problem solving or subject matter) will require the greater amount of instructional time to complete a given unit of instruction in vocational agriculture.
4. Will there be a difference in student attitudes toward the instruction as a result of being taught with a problem solving approach as opposed to a subject matter approach as measured on a 15 item Likert scale attitude instrument.

The following research hypotheses were tested:

Students taught with the problem solving approach will score significantly higher on an achievement test than students taught with a subject matter approach to teaching.

Students taught with the problem solving approach will have higher retention of knowledge than students

taught with a subject matter approach to teaching.

Students taught with the problem solving approach will have a more positive attitude toward the instruction and exhibit more motivation to learn than students taught with a subject matter approach.

The problem solving approach to teaching will require more instructional time to complete a unit than a subject matter approach.

#### DEFINITION OF TERMS

The independent variables for the study were approach to teaching a unit in vocational agriculture and timing of the unit in the instructional series. There were two levels of the independent variable teaching approach, the problem solving approach to teaching and a subject matter approach to teaching. There were two levels of the independent variable timing of the unit, the unit was taught first in the series or the unit was taught second in the series. Student knowledge of the subject matter prior to the start of the instructional unit was used as a covariate in the study. Student knowledge was measured on a pretest given at the start of the unit. The dependent variables were student achievement, student retention, and attitude toward instruction.

## DEFINITIONS

Approach to teaching - The approach to teaching will be the problem-solving approach and a subject matter approach as defined by Newcomb, McCracken, and Warmbrod (1986).

Problem Solving approach - A student-centered approach to teaching where the central and essential characteristic is solving problems (Binkley and Tulloch, 1981). Students participate in the learning process by contributing problems, analyzing the factors associated with the problems, developing possible solutions to the problems, placing the solution(s) into action, and evaluating the results of the solution.

Student achievement - The score on a posttest designed to measure knowledge and application of the materials presented in the instructional unit.

Student retention - The difference between the posttest given at the end of the unit and a second parallel posttest given two weeks later.

Student attitudes - The score from a Likert scale instrument administered at the end of the first posttest designed to measure the attitudes of the students toward the different approaches to teaching.



Subject matter approach - A teacher-centered approach to teaching where students are passive participants in the learning process. Students listen to the information, take notes, and retrieve or recall the information for evaluation purposes.

#### LIMITATIONS OF THE STUDY

The study was limited to seven teachers who use a problem-solving approach to teaching with their vocational agriculture students. The teachers were purposefully selected from the list of vocational agriculture in the state of Ohio. The data collection was limited to data collected from one instructional unit taught to high school freshmen students.

## CHAPTER II

### REVIEW OF LITERATURE

To acquire knowledge concerning the problem solving and subject matter approaches to teaching and their effects upon student achievement, retention of learning, attitude toward instruction, and motivation, a review of literature was conducted. The inquiry focused upon four major areas: a) the problem solving approach to teaching in teaching methods text books, b) the problem solving approach in agricultural education literature, c) psychology of problem solving, and d) research on problem solving in agriculture.

#### The Problem Solving Approach in Teaching Method Text Books

The problem solving process has enjoyed a successful history in agricultural education. The problem solving process used in vocational agriculture is described in a process known as Dewey's Steps in Reflective Thinking (Newcomb, McCracken & Warmbrod, 1986). Dewey's Steps in Reflective Thinking have been used, adapted, and incorporated in many of the teaching

methods texts published for use by vocational agriculture teachers. A review of literature on problem solving in vocational agriculture should begin with the publications of these distinguished authors.

John Dewey's Steps in Reflective Thinking are also known as The Chain of Reasoning, The Method of Science, The Learning Process, and The Scientific Method. The six steps in Dewey's Reflective Thinking included; a) experiencing a provocative situation, b) defining the problem - clarifying questions to be answered, c) seeking data and information, d) formulating possible solutions, e) testing possible solutions, and f) evaluating the results (Newcomb, McCracken & Warmbrod, 1986).

Lancelot (1944) described general thinking ability as one of the five most important types of human abilities. He stated that the ability to think well ranks among the greatest of all factors in determining human achievement and success. He expressed concern that schools were not developing thinking abilities. Lancelot argued that students could only learn to think well by actually thinking.

Lancelot (1944) described a thinking process that could easily be made habitual by high school pupils. The process included the following four steps:

1. Reach an early inference, a tentative opinion, as to the probable answer of the problem, based carefully upon such facts as are already known.
2. Search for further available facts.
3. Revise or change the original inference in such a manner as to bring it into closest possible agreement with all of the facts that have been brought together. The revised inference is called the conclusion.
4. Test the soundness, or validity, of the conclusion by noting how fully it meets the four standards below:
  - A. No bias, prejudice, or feeling should have been allowed to enter into the thinking process or to influence the conclusion in any way.
  - B. All facts that seem to have any important bearing upon the question should have been found.
  - C. The conclusions must not be in actual conflict with any important fact.
  - D. The conclusion should be so strongly supported by the body of facts, or evidence, taken as a whole, that it seems to have been proved true beyond any reasonable doubt.  
(pp. 91-92)

Lancelot (1944) outlined six procedures for developing general thinking ability in students. They were:

1. Make constant use of problems and questions which require superior thinking, yet which are suited to the ability of the majority of the pupils.
2. Make assignments in such a manner that study by the pupils will be a problem solving process, or if topics are used, a process of organizing and interpreting facts, as distinguished from one of memorization.

3. Endeavor to guide the study of the pupils so they will form the habit of using the modern scientific thinking process.
4. Lead class discussions in such a manner that they will follow the steps of the modified scientific thinking process.
5. Test occasionally with special care conclusions or opinions expressed casually by members of the class using the standards given in the fourth step of the process.
6. Exert constant, quiet pressure against poor reasons and against loose or careless thinking; and endeavor to teach essential knowledge so that it will be retained and used in the future thinking of the pupils. (pp. 95-96)

Hammonds (1950) outlined a problem solving process in his publication Teaching Agriculture. The process was based upon the fact that thinking and problem solving are intimately related. Hammonds related the steps of problem solving to the steps in reflective thinking. His philosophy of problem solving can best be summed up in the following statement, "Enrichment of meaning, development of understanding, acquiring information in a useful form, preparation for meeting new situations intelligently, all call for thinking. Also, training to think well in any given field or subject (agriculture, for example) is one of the desired results of instruction in it. If a person is taught to think in a field, he must think while he is being taught. One learns to think in a field or subject by thinking in it" (Hammonds, 1950, p. 102).

Hammonds drew a parallel between his six step process to problem solving and the process established by John Dewey. The six step process to problem solving developed by Hammonds was:

1. Discover the difficulty in a situation.  
Difficulties do not exist apart from situations.
2. State the problem which when solved will remove the difficulty.
3. Analyze the probable, with the group, so they may see how to solve the problem.
4. Each student finds the information needed that he does not possess and solves the problem.
5. Through a discussion, under teacher guidance, pool the findings and decisions and arrive at a final conclusion.
6. Do whatever needs to be done to remove the difficulty.

Stewart's (1950) publication, Methods of Good Teaching , presented the problem solving procedure under four patterns. The four patterns included; a) the forked road approach, b) the possibilities-factors chart, c) given a situation to be improved, and d) given an effect, to find the cause or causes.

In addition to the four patterns for problem solving, Stewart outlined the characteristics of a good problem. The characteristics were:

1. It is clearly and definitely stated.
2. It is appropriate in its size and in the degree of difficulty - not too easy and not too difficult.

3. It requires thinking of quality and quantity.
4. It is true to life.
5. It makes use of other interest techniques, meaning other than true to life.

Krebs observed the difficulties encountered by teachers attempting to incorporate the problem solving approach in teaching vocational agriculture. Krebs (1967) authored For More Effective Teaching, an effort to explain and demonstrate his concept of problem solving approach in teaching. The book covered the concepts of planning, variations of the problem solving approach, trouble spots with problem solving, and using the problem solving in teaching adults. The book also contained examples of unit and lesson plans developed around the problem solving approach. One chapter of the book was devoted to "concepts about learning."

Binkley and Tulloch (1981) in Teaching Vocational Agriculture/Agribusiness outlined a six step procedure in problem solving. Their six step approach included:

1. The students discover the difficulty in a situation.
2. The students state the problem which, when solved, will remove the difficulty.
3. The teacher analyzes the problem - gets out the factors to consider - with the group members so they may see how to solve it.
4. Each student finds the information needed that is not already possessed and solves the problem.

5. Through a discussion, under teacher guidance, the students pool the findings and decisions and arrive at a final conclusion.
6. The students do whatever remains to be done to remove the difficulty.

In addition, Binkley and Tulloch (1981) outlined ten chief reasons for using problem solving in teaching.

They were:

1. The problem acts as a selective agency in gathering pertinent facts and organizing them into a connected viewpoint.
2. In problem solving, significant and appropriate facts are taught in useful association and thus will be more likely to be used again when the need arises.
3. Problem solving places emphasis on use of material rather than on memorization of it.
4. The solving of a problem by the learners calls for the use of old things in new ways.
5. Problem solving in teaching contributes to the development in the learners of a habit of evaluation and using data intelligently in a new situation.
6. Since problem solving calls for pausing and weighing the possibilities and alternatives, it contributes to the development of open-mindedness.
7. Proper use of problem solving should contribute to teaching the learners to discover problems.
8. When problems are used in teaching, the learner always has an idea of what is to be done in solving the problem.
9. Problem solving lends itself to learner participation in all its steps or phases.
10. The many variations in kinds of problems and methods of solving them give rich opportunity for flexibility in teaching procedures.



Crunkilton and Krebs (1982) provided a revision of For More Effective Teaching in their version of Teaching Agriculture through Problem Solving. In addition to the material covered in the original version, the 1982 book included using problem solving to control discipline, motivating students, and developing a course of study for agricultural education.

Newcomb, McCracken & Warmbrod (1986) outlined a six step problem solving approach to teaching. The steps were:

1. Interest approach
2. Group objectives
3. Questions to be answered
4. Problem solution
5. Testing solutions through application
6. Evaluation of solutions

#### Summary

The problem solving approach to teaching has a deep history in agricultural education. The history is evident in the teaching methods books written by respected members of the profession. Each of the methods have slightly different steps to the problem solving process but each can trace its roots to the works of John Dewey. Authors such as Crunkilton and Krebs provided specific instructions for teachers to use

in preparation of their lesson plans.

The Problem Solving Approach in Agricultural Education Literature

The Agricultural Education Magazine has served as the voice of the agricultural education profession. Articles on the problem solving approach to teaching first appeared in the magazine as the problem method, and the problem solving method. The articles provided instructions for teachers on how to incorporate the problem solving approach in the teaching of vocational agriculture.

Liggett (1951) pointed out the problem solving approach to teaching was one of the more effective methods and one of the most difficult to master. He recommended that for problems to be effective, they must concern the individual student. Hypothetical problems would not be as effective as real problems the students encountered on their own farms and brought to the instructor for help and advice. In solving these problems Liggett recommended the teacher keep in mind four things, a) the cause, b) the resulting problem, c) preventive measures which might have been carried out, and d) corrective measures to use after the problem has arisen.

Clover (1953) outlined for the readers a problem method that worked for him. The method hinged on "drawing real problems" from the class. The eleven step process included: a) draw real problems from the class members, b) select a problem, c) state the problem clearly, d) seek probable answers from the class, e) seek authority, f) discussion to correct inference, g) will our recommendation to the boy (sic) work for him?, h) are there others in the class who might use these recommendations?, i) summary of principles learned-notes, j) measuring the progress of students, and k) follow-up visits.

Sutherland (1948) promoted a six step approach to teaching with the problem solving approach. His steps included; a) get a statement of the problem, b) have it limited and defined more clearly, c) get inferences and opinions as to possible courses of action, d) get additional facts, e) revise original inferences and get additional inferences, and f) test and weigh each conclusion and decide upon the best one. Sutherland (1948) indicated, "Since the class procedure follows a normal thinking procedure, it is relatively easy for teachers to use it and pupils to follow it. Even beginning teachers have used it successfully in their first trial after they have seen it demonstrated (p.

30)." He concluded that the method was interesting to students because the problems are actual true-to-life situations.

Agricultural Education Magazine articles in the 60s, 70s, and 80s were based upon recommendations for using the problem solving approach. Crunkilton (1985) outlined six tips for using problem solving. He recommended that teachers must believe in the process, that lessons must be planned, teachers need to follow the correct steps for the process to work effectively, teachers need to be familiar with the technical content to be taught, students must be taught about the problem solving process, and students must be given the opportunity to practice what they have learned.

Schumann (1979) argued that the problem solving approach must remain the philosophical basis for instruction in vocational agriculture. He warned that when the problem solving approach is improperly utilized the result can be a disorganized and confused instructional program.

Newcomb (1976) argued that vocational agriculture teachers should promote inquiry in their teaching. He wrote that learning is an active process and students should inquire into rather than being instructed in the subject matter. The teacher should guide students in their search for knowledge. The principle points used

in the article are the basic concepts of the problem solving approach to teaching.

Van Berkum (1979) wrote that motivation was the key to the problem method. Motivation can come from dealing with real problems brought up in class or uncovered during supervisory visits. He argued for shorter units, student participation, and student application of solutions.

Rosenfeld (1983) in the Phi Delta Kappan argued that one of the contributions of vocational agriculture was its use of a problem-solving approach to teach science and mathematics. He indicated the students were taught to use the scientific method and not to simply follow procedures.

Newcomb (1974) argued the key concept of the problem solving approach in the following statement: "If students are to be intrigued with learning, they must face the problems of the real world and find solutions to real problems" (p.125). He wrote that if teachers would follow this paradigm of teaching they would have successful teaching careers. The key to the success would be the use of a variety of methods of instruction in teaching answers to questions.

Dickerson (1984) in "A Reexamination of the Basics in Agricultural Education" writes that if students are

to learn how to make decisions and think rationally about problems in agricultural occupations, they must have experience in that occupation. He went on to state that agricultural educators must return to using the problem solving approach as a way of teaching or vocational agriculture is on its way to becoming a nonvocational program.

By 1984 challenges to the problem solving approach began to surface. Crunkilton (1984) and Moore and Moore (1984) debated the merits of the problem solving approach to teaching in an issue of the Journal of the American Association of Teacher Educators in Agriculture. Moore and Moore (1984) argued that the problem solving approach had no scientific data to verify its claim to being a superior method of teaching vocational agriculture. They pointed out that other approaches must be tried and a variety of techniques of instruction incorporated into the vocational agriculture programs. Crunkilton (1984) responded with evidence for the individual steps and concepts of the problem solving approach.

#### Summary

Just as the problem solving approach to teaching was well represented in the agricultural education teaching methods text books, the approach to teaching

has received attention in The Agricultural Education Magazine and The Journal of the American Association of Teacher Educators in Agriculture, two publications that have served as the voice for the profession. The articles have ranged from hints and suggestions for implementing the problem solving approach of teaching in the classroom to criticism of the lack of empirical evidence for the merits of the approach to teaching.

#### Psychology of Problem Solving

Green (1966) identified two schools of thought on the psychology of problem solving. One approach is that problem solving is an extension of the learning process. The other approach is that learning is often problem solving in disguise. A four stage psychological problem solving model was offered. The steps included preparation, incubation, inspiration and verification. Skinner (1966) defined problem solving as being concerned with the relations which prevail among three terms: a stimulus, a response, and a reinforcing consequence. Gagne' (1970) also presented a four step model to problem solving. The steps were presentation of the problem, definition of the problem, formulate hypotheses, and verification of the solution.

The conditions for the occurrence of problem solutions has a major emphasis on the previous learning

of the problem solver, perhaps interacting with the structure of the problem (Green, 1966). Experience in solving problems may either help or harm the problem solver. Habit and conformity are two barriers to effective problem solving (Davis, 1973).

Evidence suggests that it is better to teach solution paradigms through a discovery approach than through instruction of the paradigm (Cameron, 1985). Problems must be well structured. Fuzzy problem solving skills can be enhanced by increasing knowledge about theoretical foundations for decision making, learning structured techniques, and practice with relevant application exercises.

Gagne' (1966) defined internal and external conditions that must be present in problem solving. Internally, the problem solver must have knowledge of a problem solving process. Externally, stimuli, verbal directions, and instructions must be present. The instruction will stimulate the recall of the concepts or a certain set of principles. Individual differences in problem solving abilities will develop in the following areas: a) amount of information stored, b) ease of recall, c) concept distinction, d) fluency of hypotheses, and e) retaining the solution model.



Davis (1973) outlined questions that should be asked to determine if the situation is a true problem.

They were:

1. Is the problem really a problem?
2. Does the task elicit observable trial-and-error behavior or implicit problem solving and thinking?
3. Does the task require one "correct" solution or many original ones?
4. Is the problem a fairly well-defined, one-shot affair, or is it a creative contribution of substantial magnitude, requiring the creative solving of multiple sub-problems?

Winne and Marx (1979) felt that a teacher should build on what students already know. Students are constantly thinking, trying to determine what is supposed to be learned, deciding how might one go about learning it, and applying those mental operations to see that actual learning takes place. Based upon this assumption, students can be trained to use a perceptual problem solving strategy for selecting information from the instruction environment that is necessary for learning. Almost all educational programs are built upon the basic premise that human beings have the ability to transfer what they have learned from one situation to another (Deese, 1967).

Hudgins (1966) identified key elements of applying the problem solving process to the classroom. The

learners' behavior in the problem solving process must be goal oriented. The problem solving process was characterized by uneven advances toward a solution. The solution to the problem can only occur after the learner develops a new relationship between the stimuli. The response to the problem must be reinforced. Crutchfield (Biehler, 1982) states that higher cognitive problem solving skills must be reinforced through repetition and reinforcement.

Kearney (1986) advocated incorporating problem solving into existing curriculum. Incorporating problem solving into existing curriculum will reduce budgets, give students more application time, and take less time from the subject area. If teachers are successful in teaching students to think they cannot expect that they will limit their thinking to prescribed subject matter.

Unsuccessful students have little confidence in their ability to solve problems (Broder, 1987). If problems appear complex they may give up before trying or guess at the answer. The unsuccessful students are more likely to introduce personal considerations into the problem solving process. Better thinkers may be different from less effective thinkers largely in how they approach problems, rather than in their "mental hardware."

The role of a teacher in the problem solving process is a complex one. The teacher will supervise the selection of students' problems, provide guidance to the students, and reinforce problem-solving behavior. The most important function of the teacher is to assist the students in development of problem solving skills (Hudgins, 1966). Teaching practices involving group discussion and participation can be expected to yield superior results to individual problem solving. Participation in group or individual problem solving exercises are not superior to each other when it comes to the development of individual abilities to solve problems. The changes in problem solving skills probably depend most heavily upon pupils learning methods; the ability to comprehend the point of the problem, analyze the problem into components, and select and apply to the problem the appropriate skills and knowledge to facilitate the solution to the problem. Suchman states that teachers should help children by posing problems that are reasonably structured and will lead to exciting new discoveries. The teacher can coach the students in data collection and organization (Biehler, 1982).

Biehler (1982) outlined ways that teachers can help students become more systematic problem solvers. They

were:

1. Present problems yourself or encourage students to state problems of their own.
2. Encourage and help students find information relating to the problem.
3. Allow for an incubation period.
4. When the illumination occurs urge students to state solution in the form of hypotheses.
5. Test the hypotheses.
6. Help students recognize and define the problem.
7. Help students ask the right questions.
8. Encourage the generation of many ideas.
9. The generation of ideas should be free and intuitive.
10. Develop persistence by starting out with quick solutions.

Broder (1987) outlined seven ways educators can help students learn the problem solving process. The ways included:

1. Help students recognize that problem solving does not progress in a simple straightforward fashion from problem to solution.
2. It is possible to use more than one way to solve a problem correctly.
3. Teachers can demonstrate how to break a problem down into manageable parts.
4. Review the intermediate steps that experts use.
5. Break students into pairs or small groups for practice. One student will work at solving the problem and the other listening to the problem solving process.

6. Suggest students develop a plan for the solution of a problem prior to plugging numbers into an equation because it contains correct variables.
7. Isolate factors that lead toward erroneous solutions and develop strategies that check these tendencies.

Mentz (1981) offered the following four suggestions to teaching problem solving. Students must be practiced in the ability to "see" and the propensity to look for, relationships. Students should practice proportionalities, metaphors, and analogues. They should practice exercises in classifying and ordering as a more specific way of relating. They should also practice clarifying problems, and rendering them well defined.

Training in problem solving must be embedded in a subject matter discipline. Woods (1987) outlined three conditions that must be present for problem solving to take place. Students must possess knowledge or information to solve problems, but how they learn information affects how they solve problems. The students must possess tacit knowledge or experience in the problem area. The students must possess a domain of knowledge or experience that is called problem solving. However solving many problems is ineffective in developing problem solving skills.

Davis (1973) outlined the attitudes that students should have to be effective problem solvers. These attitudes included: a) positive orientation toward new and innovative ideas, b) constructive discontent - referring to the notion that any manmade object or process may be changed for the better, c) awareness of the importance of new ideas in all aspects of our fast-changing society, and d) notion that we can learn to be more imaginative problem-solvers.

Nugent (1982) reported that writing is one of the best ways to teach problem solving and critical thinking. Teachers sometimes use reasoning, reading, and writing in their teaching. If they add computation then students could formulate hypotheses, try solutions, test generalizations, and verify solutions.

The social environment is an important factor in student problem solving abilities. Intellectual activity cannot flourish under circumstances which demands rigid conformity. To avoid set and rigidity in the classroom the atmosphere must reinforce attempts to vary strategy in seeking solutions to problems. The teacher should insert an occasional problem which demands the application of a different principle.  
(Hudgins, 1966)

Once a repertoire of concepts and operations has been taught, problem-solving behavior consists of applying strategies for analyzing the nature of a problem to help determine which operations in which sequence will produce a solution (Becker, 1971). When a problem solution is achieved, something is also learned (Gagne', 1970). When students are presented with the same class of situation and the problem can be responded to by means of recall then the situation can no longer be looked upon as a problem. Retention of information learned through the problem solving process was found to be very high when measured after nine weeks.

Great discoveries usually involve an inductive leap, a combining of ideas that come from widely separated knowledge systems. The final task of problem solving may be shown to derive facilitation from previously learned relevant rules.

Hudgins (1966) reported that group or individual problem solving was not superior in the development of problem solving abilities in students. The quality and quantity of problem solutions do differ between problem solving groups and problem solving individuals. Large, Fox, Davitz, and Breenen found the relative quality of the products produced by groups is superior to products produced by individuals (Gall, 1976). Taylor, Berry,

and Block found that individuals outperformed the real groups in number of ideas generated, number of unique ideas generated, and quality of ideas (Gall, 1976). Restle and David found that problem-solving groups tend to operate below the level of their best members.

Maier (Gall, 1976) outlined four factors that have an adverse factor on problem solving groups. The factors are: a) groups without a designated leader, b) once a group selects a solution, a higher quality solution will be rejected, c) a capable individual may not have the opportunity to influence a decision if a less capable individual dominates the decision, and d) group members are subverted from their initial goal of solving problems to converting other group members to their point of view.

Green (1982) described the relationship of knowledge to problem solving. Cognitive psychologists now believe that very little information is forgotten. New information either overlays or modifies old information. Larkin (1979) reported that experts work forward from the quantities given in the problems to the desired unknown, whereas the novices work backward from the unknown to the givens. Students' learning is better if they solve a problem themselves instead of listening to a solution. However, they need careful guidance so



the process of developing the correct explanations with as few errors as possible is made along the way.

Mentz (1981) found that material and instruction used in college classes assumes that reasoning capacities of students are either already developed or that they develop automatically. The result is skills that develop are often so "content bound" that a change of subject matter renders the student impotent and requires the complete relearning of otherwise structurally similar methods and strategies. Factual learning is the necessary nexus out of which and by means of which general problem solving skills are required. Content learning is one sided and incomplete. Cognitive meta-skills of problem solving are transferable to widely differing content situations.

When students are given complex word problems that overload their working memories, they do not rely on the straightforward translation-plus-solution strategy. Rather they appear to rely on a successive chunking procedure in which segments are translated and operated upon in a piece-by-piece way (Mayer, 1980).

Norman (1984) wrote of the use of problem solving in the medical field. In the 1960s medical education moved away from emphasizing the acquisition of rote knowledge toward the development of problem-solving

strategies. Norman found that the experienced clinician is a better problem solver by virtue of accumulated experience, not as a result of innate or learned problem solving skills. Experts in problem solving are experts because they think of better, more correct, or more appropriate hypothesis very early on in the problem solving process. Norman (1984) reported that 95% of correct diagnoses are thought of in the first five minutes. The problem solving difficulties of novices can be attributed largely to the inadequacies of their knowledge base and not to limitations in their problem solving ability. Students increase consistently in recall with increased experience.

How do novice problem solvers differ from expert problem solvers? Chi (1981) explored this question. The finding indicated three major differences between novice and expert physicist. They were: time to solution, the pause time between retrieving successive equations or chunks of equations, and additional errors made by novices. Experts will make more complete knowledge statements than novices.

Several states are developing and implementing assessment programs aimed at higher order thinking skills. Textbooks publishers and testing companies have become increasingly active in this arena. Kearney

(1986) outlined some of the skills that constitute higher order thinking skills. The list included: comparing and contrasting, making inferences, analyzing events, synthesizing information, drawing conclusions, identifying the problem, analyzing the problem, suggesting possible solutions to the problem, testing consequences of possible solutions, assessing the reliability, relevance, sufficiency, validity, and meaning of data, analyzing arguments, judging credibility of sources, observing and judging observations and reports, induction, deduction, assumption identification, prediction, identification of fallacies, definition of problems, distinguish between differences of kind and differences of degree, underlying verbal analogies, selection of a solution process, selection of a way of representing a solution, selection of a problem-solving strategy, allocation of processing time, sensitivity to feedback, translocation of feedback into an action plan, implementation of an action plan, testing hypotheses, linear reasoning, data gathering, decision making, classifying, organizing, identifying alternate points of view, recalling, grouping/labeling, classifying/categorizing, ordering, and prioritizing.

Alfred Whitehead defined inert knowledge as knowledge that is accessed only in a restricted set of contexts even though it is applicable to a wide variety of domains (Bransford, 1984). Traditional practices tend to produce knowledge that remains inert. To become useful for thinking, facts and procedures must be transformed into conceptual tools. The idea of a powerful set of "helps" or tools for enhancing problem solving seems to be very important. Successful programs may have measures that look poor because evaluation fails to reflect what is learned, different students make gains in different areas, or measurement is of individual and not group efforts.

#### Summary

The education profession in general has devoted considerable attention to incorporating problem solving in the curriculum. Evidence was presented for the psychology of teaching problem solving. The teaching of problem solving must be imbedded in a subject matter discipline rather than trying to teach problem solving as a discipline in itself. In general problem solving has been used by the educational profession to improve higher order thinking skills of students.

### Research on Problem Solving in Agriculture

Much has been written about the use of problem solving in agricultural education, but little research was offered to substantiate the effectiveness of the approach to teaching. Flowers (1986) conducted an experiment to compare the effects of the problem solving approach and the subject matter approach to teaching on a selected problem area of agriculture. The study used student achievement, retention, and attitudes toward the teaching method as criteria to determine the effectiveness of the two approaches.

The study was conducted with five teachers in Illinois who had two sections of Vo-Ag I students. There were 68 students in the problem solving treatment and 61 students in the subject matter treatment. Students were given a pretest, a unit of instruction, a posttest, and a second posttest fourteen days later.

There was no significant difference between students taught by the problem solving approach and students taught the subject matter approach on student achievement, retention tests scores, student attitudes toward the teaching method, and time required to complete instruction in the problem area. There was a significant difference between students taught by the problem solving approach and students taught by the

subject matter approach on student retention as measured by the difference between the scores on the achievement test and the retention test in favor of the problem solving treatment group.

Chuatong (1986) examined how students in vocational horticulture could be described in terms of their ability to solve problems in technical horticulture and what relationships exist between problem solving ability and academic aptitude of students, extent to which teachers use problem solving teaching behavior, degree of student involvement is supervised occupational experience, degree of students; participation in FFA, grade level of students, and emphasis of the program in which students are enrolled.

One hundred thirty-three junior and senior horticulture students participated in the study representing eight joint vocational schools, 14 teachers, and 14 classes of vocational horticulture students in the state of Ohio. The following conclusions were developed as a result of the investigation:

1. Most students have less than an average level of academic aptitude and do not demonstrate a very high level of problem solving ability.
2. The higher the academic aptitude and general knowledge in horticulture the better students tend to be able to solve problems in horticulture.

3. Senior students are more likely to acquire more extensive knowledge in general horticulture but are not more likely to solve horticulture problems than junior students.
4. The more students are involved in supervised occupational experience, the more likely they will acquire knowledge in general horticulture and the better they tend to perform when solving problems in horticulture.
5. Students who participate in FFA tend to have a higher level of knowledge in general horticulture. However, FFA participation is not likely to vary with problem solving ability.
6. Teachers perceived extent to which they employ problem solving teaching behaviors is related to achievement but not to problem solving ability in horticulture.
7. Academic aptitude explained the highest proportion of variance in problem solving ability and achievement in horticulture.
8. When academic ability is held constant, program variables together may be used to explain problem solving as well as achievement in horticulture of students.

Kirts (1983) studied student teachers at Missouri-Columbia to ascertain the effect which classroom experience using the problem solving approach had on the questioning strategies of the student teachers of vocational agriculture. Student teachers audiotaped lessons representing no experience, one week of experience, and four weeks of experience using the problem solving approach. The questioning strategies were measured on the following seven dependent variables; question quantity, cognitive quantity,

cognitive quality, tactical versatility, question success, reaction quality, and cognitive versatility.

Student teachers of vocational agriculture using the problem solving approach asked more higher level questions, more lower level questions, and fewer procedural questions than teachers and student teachers not using the problem solving approach. Questioning strategies remained relatively stable except for cognitive quantity and reaction quality for the student teachers of vocational agriculture with three levels of classroom experience using the problem solving approach.

Peterson (1969) completed a study of the principles approach to teaching. Within the principles approach the teacher provided factual information concerning the subject matter along with directing the students through several problem-solving situations which have direct agricultural application. He found students achievement was significantly greater for students taught agriculture based on principles. There was not a difference in students' attitude toward the teacher and the teaching method. The teachers' opinions revealed that teachers felt the principles approach resulted in improved instruction.



### Summary

There has been little research on the effect the problem solving approach has on student achievement and retention of learning. The results of the research provide inconclusive evidence on the effect of the approach as compared to a subject matter approach. The inconclusive evidence points to the need for further study in the area to establish the problem solving approach as an effective approach of instruction.

The problem solving approach has been recommended as the best approach to use in teaching vocational agriculture, but there is not a research base to support that statement. There has been only one study that has directly addressed the issue. There is a need for continued research in the area of the problem solving approach.

### CHAPTER III

#### METHODOLOGY

The purpose of this study was to evaluate the effect of approach to teaching (problem solving and subject matter) on student achievement, retention, and attitudes toward instruction as compared with a subject matter approach. The problem solving approach has long been accepted as an effective way to teach vocational agriculture (Liggett, 1951; Sutherland, 1948). The problem solving approach to teaching has been recommended by numerous experts on teaching methods for vocational agriculture (Lancelot, 1944; Hammonds, 1950; Stewart, 1950; Krebs, 1967, Crunkilton and Krebs, 1982; Binkley and Tulloch, 1981; Newcomb, McCracken, and Warmbrod, 1986).

The independent variables were the approach to teaching and the timing of the instructional unit. There were two levels of the independent variable approach to teaching: the problem solving and subject matter approaches and two levels of the independent variable timing of the unit: first and second unit

taught in an instructional series. The dependent variables were student achievement, student retention, student attitudes, and time necessary to complete the unit.

### Research Design

The study used a variation of Campbell and Stanley's (1963) quasi-experimental counterbalance design. A quasi-experimental design was selected because teachers were purposefully selected on the basis of their expertise in using the problem solving approach and therefore random assignment of students to experimental treatments was not possible. The counterbalance design was selected to control the extraneous variables of teacher effectiveness and student knowledge of the subject area. The teacher effectiveness and student knowledge variables were controlled because both teacher effectiveness and student knowledge of the subject area were used with both levels of the independent variable.

The teachers and their class of high school freshmen students who participated in the study were randomly assigned to one of four groups (Figure 1). Group 1 students were given a pretest (O1) on "Weed Control in Corn," prior to the time the "Weed Control In Corn" unit (XWP) was taught using a problem solving

approach. Immediately following the completion of the unit of instruction a posttest (P2) on "Controlling Weeds in Corn" was administered. An attitude toward instruction instrument (A1) was administered immediately following the posttest. Fourteen days after the first posttest was administered, a second posttest (F3) on "Controlling Weeds in Corn" was completed by the students. The students started on the second unit of instruction immediately after the completion of the first posttest on the "Weed Control in Corn" unit was given. A pretest (O4) was administered and the "Preparing Beef Cattle for Show" unit (XBS) was taught using a subject matter approach. Immediately following the completion of the "Preparing Beef Cattle for Show" unit a posttest (P5) on "Preparing Beef Cattle for Show" was administered. An attitude toward instruction instrument (A2) was administered immediately following the posttest. Fourteen days later a second posttest (F6) on "Preparing Beef Cattle for Show" was completed by the students.

Group 2 students were given a pretest (O7) on "Weed Control in Corn," prior to the time the "Weed Control In Corn" unit (XWS) was taught using a subject matter approach. Immediately following the completion of the unit of instruction a posttest (P8) on "Controlling

Weeds in Corn" was administered. An attitude toward instruction instrument (A3) was administered immediately following the posttest. Fourteen days after the first posttest was administered, a second posttest (F9) on "Controlling Weeds in Corn" was completed by the students. The students started on the second unit of instruction immediately after the completion of the first posttest on the "Weed Control in Corn" unit was given. A pretest (O10) was administered and the "Preparing Beef Cattle for Show" unit (XBP) was taught using a problem solving approach. Immediately following the completion of the "Preparing Beef Cattle for Show" unit was completed a posttest (P11) on "Preparing Beef Cattle for Show" was administered. An attitude toward instruction instrument (A4) was administered immediately following the posttest. Fourteen days later a second posttest (F12) on "Preparing Beef Cattle for Show" was completed by the students.

Group 3 students were given a pretest (O13) on "Preparing Beef Cattle for Show," prior to the time the "Preparing Beef Cattle for Show" unit (XBP) was taught using a problem solving approach. Immediately following the completion of the unit of instruction a posttest (P14) on "Preparing Beef Cattle for Show" was administered. An attitude toward instruction instrument

(A5) was administered immediately following the posttest. Fourteen days after the first posttest was administered, a second posttest (F15) on "Preparing Beef Cattle for Show" was completed by the students. The students started on the second unit of instruction immediately after the completion of the first posttest on the "Preparing Beef Cattle for Show" unit was given. A pretest (O16) was administered and the "Weed Control in Corn" unit (XWS) was taught using a subject matter approach. Immediately following the completion of the "Weed Control in Corn" unit was completed a posttest (P17) on "Controlling Weeds in Corn" was administered. An attitude toward instruction instrument (A6) was administered immediately following the posttest. Fourteen days later a second posttest (F18) on "Controlling Weeds in Corn" was completed by the students.

Group 4 students were given a pretest (O19) on "Preparing Beef Cattle for Show" " prior to the time the "Preparing Beef Cattle for Show" unit (XBS) was taught using a subject matter approach. Immediately following the completion of the unit of instruction a posttest (P20) on "Preparing Beef Cattle for Show" was administered. An attitude toward instruction instrument (A7) was administered immediately following the

posttest. Fourteen days after the first posttest was administered, a second posttest (F21) on "Preparing Beef Cattle for Show" was completed by the students. The students started on the second unit of instruction immediately after the completion of the first posttest on the "Preparing Beef Cattle for Show" unit was given. A pretest (O22) was administered and the "Weed Control in Corn" unit (XWP) was taught using a problem solving approach. Immediately following the completion of the "Weed Control in Corn" unit was completed a posttest (P23) on "Controlling Weeds in Corn" was administered. An attitude toward instruction instrument (A8) was

Figure 1  
Counterbalance Design

		5-7 Days					5-7 Days				
		14 Days					14 Days				
Group 1	O1	XWP	P2	A1	F3	O4	XBS	P5	A2	F6	
Group 2	O7	XWS	P8	A3	F9	O10	XBP	P11	A4	F12	
Group 3	O13	XBP	P14	A5	F15	O16	XWS	P17	A6	F18	
Group 4	O19	XBS	P20	A7	F21	O22	XWP	P23	A8	F24	

XW - "Controlling Weeds in Corn" Instructional Unit  
 XB - "Preparing Beef Cattle for Show" Instructional Unit  
 P - Problem Solving Approach  
 S - Subject Matter Approach  
 O - Pretest  
 P - Posttest # 1  
 F - Posttest # 2  
 A - Attitude Instrument

administered immediately following the posttest. Fourteen days later a second posttest (F24) on "Controlling Weeds in Corn" was completed by the students.

### Subject Selection

The target population for this study was all students enrolled in production agriculture in Ohio. However, due to the nature of the study, limited time, and monetary constraints the accessible population was freshmen students enrolled in 16 selected schools in Ohio.

Twenty-two teachers were identified by Dr. Lowell Hedges as excellent teachers in using a problem solving approach were selected for the study. Dr. Hedges's primary responsibility as a faculty member at The Ohio State University has been supervision of student teachers, industry teachers, first-year teachers, and selection of cooperating teachers for the department's student teaching program. These responsibilities have placed him in contact with the vocational agriculture teachers in Ohio and he has been in a position to evaluate the teaching procedures and effectiveness of many of the teachers. No other faculty member had the extensive field experience to compare with Dr. Hedges, therefore, he was selected as the expert to identify



excellent teachers who used the problem solving approach.

Dr. Hedges evaluated the teachers regarding how well their instruction included the ten essential components of problem solving approach instruction. The ten essential components of problem solving are:

To what extent:

1. Was the instruction organized around solvable problem statements?
2. Was the problem statement explored by the students?
3. Did the class develop a clear-cut statement of the problem?
4. Did students help discover possible solutions to the problem(s)?
5. Did the class discover what factors needed to be considered in accepting a possible solution?
6. Did students find and interpret information needed to analyze the potential solutions to the problem?
7. Were students helped to weigh and process the information gathered to determine its significance to the situation being considered?
8. Did the class discuss and arrive at a tentative (assumed best) conclusion to the problem?
9. Was the solution to the problem implemented under the teachers guidance?
10. Were the results of the solution evaluated and success and failure of the solution discussed?

After identification of the 22 teachers, the researcher mailed a personal letter requesting their

assistance in the study. The letter outlined a general procedure for the study.

Each student was assigned an identification number to assure that the students' identity would remain anonymous to the researcher. Each teacher was sent a coding sheet. The sheet contained internal identification codes for the study. Each teacher identified each student in the freshman class with an internal ID. Any future correspondence with the researcher would contain only the internal student identification numbers.

The accessible population consisted of all freshmen students taught by the sixteen teachers identified in the study. Since the population was purposefully selected, generalizations were limited to the accessible population.

#### Internal and External Validity

The counterbalance design controlled the internal validity threats of history, regression, maturation, testing, instrumentation, selection, and mortality.

External validity threats outlined by Bracht and Glass (1978) were considered for the study. Due to the nature of the study the target population was limited to the accessible population and all generalizations made were limited to the accessible population. To prevent

the interaction of personological variables and treatment, the study built in previous knowledge of the subject (pretest) as a measure of student knowledge of the unit. The independent variable was made explicit during correspondence with teachers who participated in the study. The approaches to teaching were explained specifically. The students were exposed to multiple treatments but the treatments were designed in such a way as to avoid a multiple treatment effect. The two units of instruction were selected in such a manner that students could not transfer information learned from one unit to the other. To eliminate the Hawthorne Effect students were not told they were participating in an experiment. The treatments were similar to what the students had been exposed to during the entire year therefore a novelty or disruptive threat was avoided. The experimenter did not administer the treatment therefore the experimenter effect was eliminated. Pretest sensitization occurs with attitude measures as pretest. The pretest for the study was limited to an achievement test. A posttest was a normal conclusion to instructional units therefore posttest sensitiation was not a problem to the study. Personal logs were kept of local history threats to validity such as school assemblies.

Validity and reliability of instruments were established using a panel of experts and pilot study to eliminate the threat of improper measurement of the dependent variable. Interaction of time of measurement and treatment effects was measured with a second posttest administered 14 days after the initial posttest.

### Procedure

The 16 teachers in the study were randomly assigned to one of four groups. Each group taught two units of instruction to their students. Each group received a pretest, a unit of instruction, an immediate posttest, an attitude toward instruction instrument, and a second posttest 14 days later. Group one taught unit A with a problem solving approach and unit B with a subject matter approach. Group two taught unit A with a subject matter approach and unit B with a problem solving approach. Group three taught unit B with a problem solving approach and unit A with a subject matter approach. Group four taught unit B with a subject matter approach and unit A with a problem solving approach.

The pretest was designed to measure student knowledge of the subject area and consisted of the same 40 questions that were used on posttest #1 and posttest

#2. Data from the pretest were used as a covariate in this study. The treatment was the teaching of a unit of instruction by the problem solving approach or a subject matter approach. Student knowledge was evaluated upon completion of the unit with one of the remaining achievement measures. An attitude toward instruction instrument was administered immediately following the posttest. Two weeks after the completion of the unit a second observation was made with the final achievement test. The purpose of the final measurement was to determine student retention of knowledge learned during the instructional unit.

Overall teaching ability and effectiveness was controlled by using a counterbalance design. Teachers and students participated in both levels of the independent variable. The design kept teacher effectiveness and student academic ability equal at both levels of the independent variable.

#### Instrumentation

The problem solving approach unit plans were prepared for each of the two instructional units. The equivalent unit plans were prepared for the subject matter approach to teaching. Copies of the unit plans were given to a panel of experts to evaluate on content validity and to suggest potential questions to be used

on the achievement tests. Forty achievement questions were developed for each of the units used in the study. The 40 questions were used on the pretest, posttest #1 and posttest #2 to insure that the three tests were identical. The questions were arranged in such a way that it would not be apparent to the students that the three tests were the same test with the order of the questions rearranged.

#### Achievement Measurement

Content validity of the achievement instrument was established with the use of a panel of experts consisting of agricultural education professors and graduate students. The panel of experts was asked to respond to the test items used in the instruments and make comments relating to their content validity.

The achievement test was not expected to have predictive validity therefore criterion-related validity was not established. No attempt was made to correlate the results of the achievement measure to other established tests therefore construct validity will not be established.

A reliability coefficient of equivalence was determined by using information returned from the first group of participants in the study. A final reliability coefficient was determined using the entire sample of

students in the study. Results of these estimates of reliability are reported in Chapter 4.

#### Verification of Treatment

Each teacher was requested to audio tape all instruction for each unit of instruction. The audio tapes were catalogued and organized on the basis of unit and teaching approach. The researcher selected for review and analysis the first half hour of each instructional unit, problem number three or its equivalent, and the unit summary to verify whether the students were receiving the experimental level of the independent variable.

#### Data Collection

A pretest was given by the teacher at the start of the unit. The teacher administered a posttest instrument at the completion of the unit. Each teacher kept a daily log to establish material covered, interruptions, and other pertinent information to the study. A follow-up posttest was given two weeks later. All data were coded on a computer disk and uploaded to The Ohio State University's Wylbur System. All data analysis was accomplished with the use of the SPSS-X statistical package.

### Data Analysis

Final analysis of student achievement was conducted using multivariate analysis of covariance with repeated measures. The covariate was the students' pretest scores. The achievement scores on the first and second posttest were the measure of the dependent variable.

To establish a more complete description of the data from the study, the researcher used a step approach where analysis of the data started with basic univariate analysis and progressed to the multivariate analysis of covariance with repeated measures procedures. The researcher used analysis of covariance with each dependent variable treated independently of the other, multivariate analysis of covariance with each dependent variable treated independent of the other, multivariate analysis of covariance with repeated measures with each independent variable treated in a univariate fashion and multivariate analysis of covariance with repeated measures where all independent and dependent variables were included in the model.

Student attitudes were determined by the scores on the attitude instrument. The scores on the items were summed and averaged to determine the individual scores on the instrument. The scores were compared using analysis of variance.



CHAPTER IV  
ANALYSIS AND INTERPRETATION OF DATA

Data for this study were collected using a quasi-experimental counterbalance design study. In part one of the chapter an analysis and verification of the teaching approaches used by the participants in the study is presented. The second part of the chapter is a description of the attitude students have toward the two teaching approaches used in the study. The third part of the chapter is an analysis of student achievement that was a result of the unit being taught first or second in the instructional series (timing) and with a problem solving or subject matter approach (teaching approach) by teachers in the study. In part four a comparison of instructional time used with the two teaching approaches is presented.

The target population was all students enrolled in vocational agriculture in Ohio. The accessible population was 121 freshman students enrolled in production agriculture in seven Ohio comprehensive high schools.

Data for student achievement were analyzed with several procedures including univariate analysis of covariance, multivariate analysis of covariance and multivariate analysis of covariance with repeated measures. The complete results of each step in the analysis are reported to better inform the reader of the dimensions of the data. The only statistical procedure used for conclusions and recommendations was the multivariate analysis of covariance with repeated measures that included both independent variables, timing of the unit and teaching approach. The results of the other analyses of the achievement data should be used only to inform the reader of the univariate aspects of the data and not to draw conclusions about the study.

Data for each of the instructional units, "Preparing Beef Cattle for Show" and "Controlling Weeds in Corn" were analyzed separately. The analysis in effect produced a study and a replication within the quasi-experimental research effort.

#### Reliability of Instruments Used in the Study

Four instruments were developed to measure attitudes toward instruction and student achievement in the study. The four instruments included The "Preparing Beef Cattle for Show" achievement test, The "Preparing Beef Cattle for Show" attitude toward instruction

instrument, The "Controlling Weeds in Corn" achievement test, and The "Controlling Weeds in Corn" attitude toward instruction instrument. The 40 questions that comprised the achievement tests were randomly ordered on three tests to be used as a pretest, posttest #1 and posttest #2. The attitudes toward the instructional approach were developed after studying an instrument used by Flowers (1986) in a similar study.

All four instruments were submitted to a panel of experts to establish their content validity. The panel of experts was composed of professors and graduate students in the Department of Agricultural Education at the Ohio State University who had previous experience teaching vocational agriculture.

Due to time constraints, reliability of the instruments was established in the following manner. The first group of instruments returned to the researcher were used as a basis for determining the reliability of the instruments. Reliability coefficients were established on the four instruments by analyzing the data from the first group of responses (n=12) returned to the researcher. Cronbach's Alpha coefficients were established at .86, .88, .90, and .86 for the Beef Attitude Instrument, Beef Unit Knowledge Instrument, Weed Attitude Instrument, and Weed Unit

Knowledge Instrument respectively (Table 1). Based on the reliability coefficients for each of the knowledge instruments, all 40 questions were used to comprise the test and both attitude instruments included all 15 of the original items. Cronbach's Alpha was used on the dichotomous items on the knowledge instruments in place of the Kuder-Richardson-20 because SPSS-X calculations for Cronbach's Alpha is equivalent to the reliability coefficient KR-20 if the data are in dicotomous form (SPSS-X, 1986).

Final reliability calculations were made with complete data from the study. Cronbach's Alpha Coefficients of .86, .76, .79, and .82 were calculated for the Beef Attitude Instrument, Beef Unit Knowledge Instrument, Weed Attitude Instrument, and Weed Unit Knowledge Instrument respectively (Table 1). These data confirmed the original decision that all instruments were a reliable measure of the knowledge and attitudes relating to the two instructional units used in the study.

A fifth instrument was designed to measure the extent to which teachers used the prescribed teaching approach to instruction when teaching each unit. The instrument contained ten essential elements of problem solving with several of the items containing subtopics.

Reliability was established on the instrument at an Cronbach's Alpha level of .96. Content validity was established by a panel of experts.

Table 1  
Reliability of Instruments Used in the Study

Instrument	Initial Cronbach's Alpha after 12 cases	Final Cronbach's Alpha at the End of Study
Beef Attitude Instrument	.86	.86
Beef Unit Knowledge Instrument	.88	.76
Weed Attitude Instrument	.90	.79
Weed Unit Knowledge Instrument	.86	.82
Teaching Approach Instrument		.96

#### Analysis of Teaching Performance Tapes

Teachers participating in the study were requested to audio tape their teaching performance from both units of instruction. The purpose of the audio tapes was to verify whether the students received both levels of the independent variable, teaching approach.

An instrument was designed to measure the extent to which teachers used the prescribed teaching approach

to instruction when teaching each unit. The instrument contained ten essential elements of problem solving with several of the items containing subtopics. Each of the ten essential elements were weighted to arrive at an weighted score between one and seven. The decision was made that an weighted score needed to be greater than four for the instruction to be considered as problem solving teaching.

Audio tapes were secured from six of the seven participants in the study. The tapes were sampled in the following manner: a) the first half-hour of each instructional unit was reviewed and rated, b) problem three (or its equivalent) was reviewed completely, and c) the unit summary was reviewed. All tapes were scored by the researcher using the teaching approach instrument.

Two of the six teachers failed to use the problem solving approach to teaching in the prescribed unit. The teachers who were proficient in the problem solving approach continued to use many elements of the problem solving approach in the units that were to be taught with a subject matter approach. The difference between the approaches ranged from .04 to 1.96 with a mean of 1.18. Weighted scores for teachers teaching the problem solving units ranged from 1.14 to 5.68 with a

mean weighted score of 3.97. The weighted scores for teachers teaching the subject matter units ranged from 1.18 to 3.73 with a mean weighted score of 2.80.

Table 2

Weighted Teaching Scores for Teachers  
Participating in the Study

Teacher	Unit	Time	Method	Adjusted Score	Difference Between Methods
1	Weeds	Second	Subject	3.73	
1	Beef	First	Problem	5.04	1.31
2	Beef	First	Subject	3.29	
2	Weeds	Second	Problem	4.26	.97
3	Beef	First	Subject	1.24	
3	Weeds	Second	Problem	2.68	1.44
6	Weeds	Second	Subject	3.69	
6	Beef	First	Problem	5.03	1.34
7	Weeds	First	Subject	1.18	
7	Beef	Second	Problem	1.14	.04
8	Beef	Second	Subject	3.72	
8	Weeds	First	Problem	5.68	1.96

The data were broken down into average scores for each of the instructional units. The weighted teaching scores for teachers completing the "Preparing Beef Cattle for Show" instructional unit were 5.03, 2.26, 1.14, and 3.72 for teachers teaching the unit first with a problem solving approach, first with a subject matter

approach, second with a problem solving approach, and second with a subject matter approach respectively (Table 3). The weighted teaching scores for teachers completing the "Controlling Weeds in Corn" instructional unit were 5.68, 1.18, 3.47, and 3.71 for teachers teaching the unit first with a problem solving approach, first with a subject matter approach, second with a problem solving approach, and second with a subject matter approach respectively (Table 4).

Table 3

Average Weighted Teaching Score for Teachers Completing the "Preparing Beef Cattle for Show" Instructional Unit

Approach	Timing of Unit of Instruction	
	First	Second
Problem Solving	5.03 n=2	1.14 n=1
Subject Matter	2.26 n=2	3.72 n=1

Teachers who were proficient with the problem solving approach to teaching often used principles associated with the problem solving approach in their subject matter approach.

Teacher 2 completed the introduction of the subject matter approach unit and stated, "What do we



Table 4

Average Weighted Teaching Score for Teachers Completing  
the "Controlling Weeds In Corn" Instructional Unit

Approach	Timing of Unit of Instruction First	Second
Problem Solving	5.68 n=1	3.47 n=2
Subject Matter	1.18 n=1	3.71 n=2

need to do to get this animal from the feedlot to the Ohio State Fair?" The teacher proceeded to use leading questions to prompt the students to explore the situation and develop a list of four problems that needed to be answered prior to solving the situation.

Teacher 8 took the students on a field trip for a part of their subject matter approach unit instruction. The field trip instruction was organized around solvable problems encountered in preparing beef cattle for show. The students would discuss possible solutions to the problems and would arrive at a possible solution to the problem. An example of leading questions used to explore the problems is "How do you break calves to lead?"

Teacher 2 used real situations to stimulate the interest of the students and to give them a potential

problem to solve for their subject matter approach unit. Classroom discussion was centered around real fields and real weed problems. Students had the opportunity to apply potential solutions to the problems during field trips conducted in connection with the unit.

Two situations were evident during the analysis of the audio tapes. Teachers who normally used the problem solving approach as a regular part of their classroom instruction failed to eliminate many elements of the approach when they were supposed to use the subject matter approach. Two of the teachers failed to use problem solving approach techniques when it was called for in the research instructions. The average margin of difference between the scores on teachers' problem solving approach unit and their subject matter approach unit was 1.18. This margin of difference was not statistically significant.

#### Attitudes Toward Instruction Approaches

Students were administered a 15 item attitude toward instructional approach instrument immediately following the completion of the instructional unit. The responses to the 15 items were on a five point Likert type scale ranging from a strongly disagree to a strongly agree. The 15 items were coded and summed to

produce an attitude toward instruction score. Student attitude toward instruction scores could range from a low of 15 to a high of 75.

Student attitudes towards instruction scores for the "Preparing Beef Cattle for Show" unit had an overall mean of 51.27, a median of 52.00, a mode of 51.00, a standard deviation of 10.18, and ranged from a low of 19 to a high of 69. The group mean attitude toward instruction scores for students who had received the "Preparing Beef Cattle for Show" unit of instruction were 57.97, 48.41, 40.08, and 49.43 for problem solving unit first, problem solving unit second, subject matter unit first and subject matter unit second respectively (Table 5).

Table 5

Average Attitude Toward Instruction Score of Students Who Received the "Preparing Beef Cattle for Show" Instructional Unit

Approach	Timing of Unit of Instruction		
	First	Second	Total
Problem Solving	57.97 n=36	48.41 n=29	53.71 n=65
Subject Matter	40.08 n=13	49.43 n=07	43.35 n=20
Average Both Approaches	53.2 n=49	48.6 n=36	51.27 n=85

An analysis of variance (Table 6) was used to determine if there were significant differences between attitude toward instruction scores. The analysis produced significant differences ( $p < .05$ ) between timing of the unit (first or second) and teaching approach (problem solving or subject matter). The analysis also indicated a significant interaction ( $p < .05$ ) between timing of the unit and teaching approach. Because of a significant interaction, the main effects will not be discussed.

Table 6

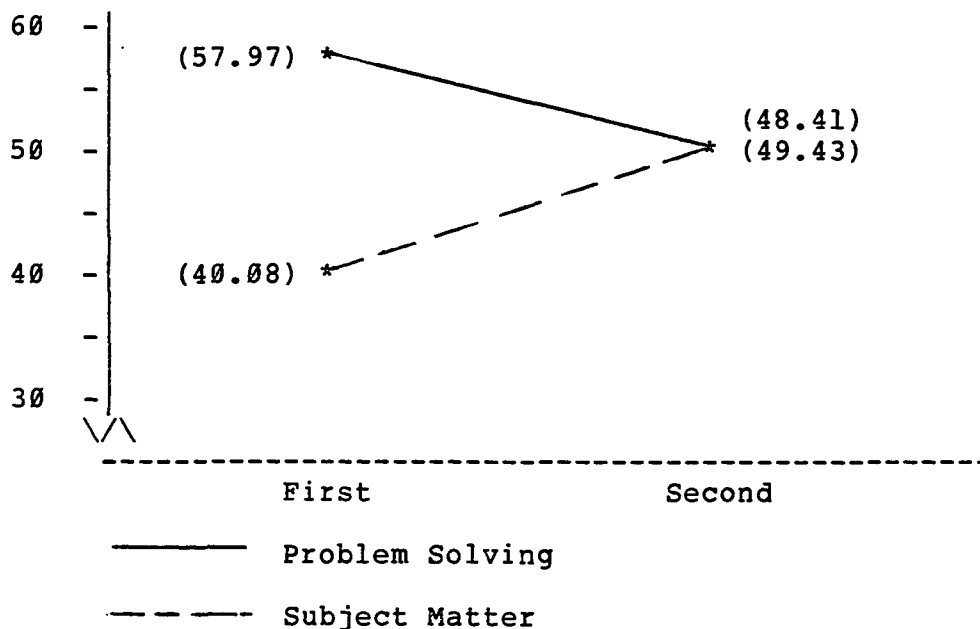
Analysis of Variance Comparing Average Attitude Toward Instruction Scores of Students Who Received the "Preparing Beef Cattle for Show" Instructional Unit

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects:	2238.262	2	1119.13	17.417	.001
Timing of Unit	597.482	1	597.482	9.299	.003
Teaching Approach	1796.572	1	1796.572	27.960	.001
2-Way Interaction:	1267.870	1	1267.870	19.732	.001
Explained	3506.132	3	1168.711	18.189	.001
Residual	5204.644	81	64.255		
Total	8710.776	84	103.700		

If the "Preparing Beef Cattle for Show" unit (Figure 2) was the first unit in the instructional series, students taught with a problem solving approach had a higher average attitude toward instruction score (57.96) than students taught the same unit with a subject matter approach (40.08). If the "Preparing Beef Cattle for Show" unit was the second unit in the instructional series, students taught with a problem solving approach had approximately the same instruction score (48.81) as students taught with a subject matter approach (49.43).

Figure 2

Student's Attitude Toward Instruction Score  
for Students Who Received the  
"Preparing Beef Cattle for Show" Instructional Unit



Student attitude toward instruction scores could range from a low of 15 to a high of 75. Student attitudes towards instruction scores for the "Controlling Weeds in Corn" unit of instruction had an overall mean of 45.56, a median of 46.00, a mode of 54.00, a standard deviation of 9.11, and ranged from a low of 19 to a high of 66.

The mean attitude toward instruction scores for students who received the "Controlling Weeds in Corn" unit of instruction were 45.12, 41.92, 42.97, and 49.28 for problem solving unit first, problem solving unit second, subject matter unit first and subject matter unit second respectively (Table 7).

Table 7

Average Attitude Toward Instruction Score of Students Who Received the "Controlling Weeds in Corn" Instructional Unit

Approach	Timing of Unit of Instruction		
	First	Second	Total
Problem Solving	45.12 n=33	41.92 n=12	44.27 n=45
Subject Matter	42.97 n=29	49.28 n=36	46.46 n=65
Average Both Approaches	44.11 n=62	47.44 n=48	45.56 n=110

An analysis of variance (Table 8) was used to determine if there were significant differences between attitude toward instruction scores. The analysis indicated a significant interaction ( $p < .05$ ) between timing of the unit and teaching approach.

Table 8

Analysis of Variance Comparing Average Attitude Toward Instruction Scores of Students Who Received the "Controlling Weeds in Corn" Instructional Unit

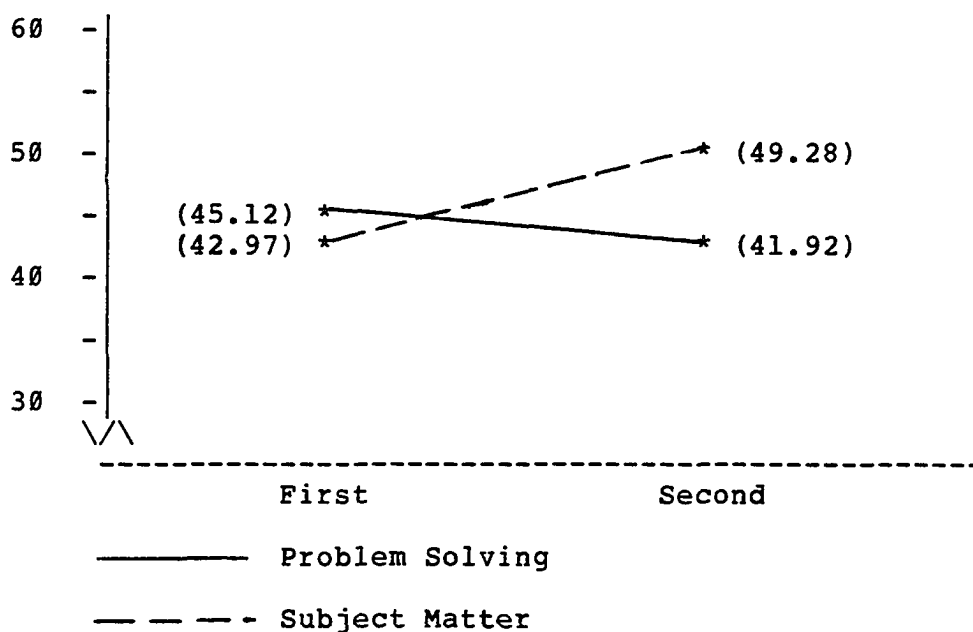
Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects:	343.533	2	171.767	2.223	.113
Timing of Unit	215.433	1	215.433	2.788	.098
Teaching Approach	44.501	1	44.501	.576	.450
2-Way Interaction:	514.902	1	514.902	6.664	.011
Explained	858.435	3	286.145	3.703	.014
Residual	8190.620	106	77.270		
Total	9049.055	109	83.019		

If "Controlling Weeds in Corn" (Figure 3) was the first unit in the instructional series, students taught with a problem solving approach had a slightly higher average attitude toward instruction score (45.12) than students taught the same unit with a subject matter approach (42.97). If "Controlling Weeds in Corn" was

the second unit in the instructional series, students taught with a problem solving approach had a lower attitude toward instruction score (41.92) than students taught with a subject matter approach (49.28). The interaction patterns (Figures 2 and 3) are different for the two instructional units.

Figure 3

Student's Attitude Toward Instruction Score  
for Students Who Received the  
"Controlling Weeds in Corn" Instructional Unit



#### Univariate Analysis of Achievement Data

The achievement test data were analyzed with univariate analysis of covariance. Each dependent



variable was analyzed separately. Pretest scores were used as covariates in the analysis (Table 9 and 10).

Table 9

Average Pretest Scores of Students Completing the "Preparing Beef Cattle for Show" Instructional Unit

Approach	Timing of Unit of Instruction First	Unit of Instruction Second
Problem Solving	20.36 n=47	20.75 n=29
Subject Matter	22.62 n=13	21.11 n=28

Table 10

Average Pretest Scores of Students Completing the "Controlling Weeds in Corn" Instructional Unit

Approach	Timing of Unit of Instruction First	Unit of Instruction Second
Problem Solving	23.56 n=28	18.46 n=13
Subject Matter	18.93 n=29	18.77 n=47

The average student score on posttest #1 for the "Preparing Beef Cattle for Show" instructional unit was 28.53, 23.17, 25.69, and 27.79 for students completing

the unit first with the problem solving approach, completing the unit second with the problem solving approach, completing the unit first with the subject matter approach, and completing the unit second with the subject matter approach respectively (Table 11).

Table 11

Average Posttest #1 Scores of Students Completing the "Preparing Beef Cattle for Show" Instructional Unit

Approach	Timing of Unit of Instruction		
	First	Second	Total
Problem Solving	28.53 n=47	23.17 n=29	26.49 n=76
Subject Matter	25.69 n=13	27.79 n=28	27.12 n=41
Average Both Approaches	27.92 n=60	25.44 n=57	26.71 n=117

The analysis of covariance procedure (Table 12) produced a significant main effect of timing of the unit ( $p < .05$ ) and a significant two way interaction ( $p < .05$ ). Because the interaction is significant the significant main effect will not be discussed.

Table 12

Analysis of Variance Comparing Average  
Posttest #1 Scores of Students Completing the  
"Preparing Beef Cattle for Show" Instructional Unit

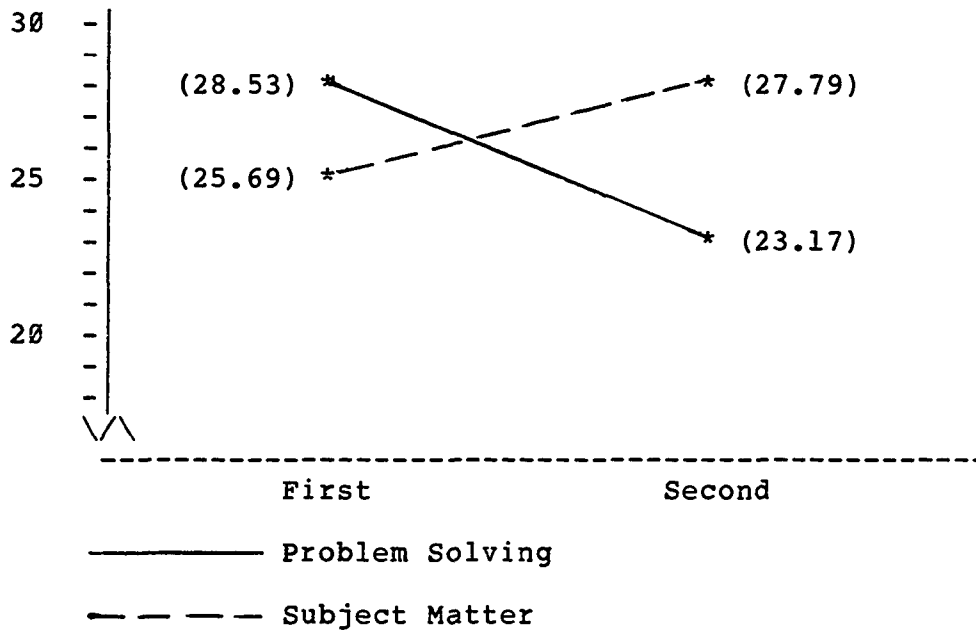
Source of Variation	Sum of Squares	DF	Mean Square	F	P
Covariate: Pretest	377.827	1	377.827	17.761	.001
Main Effects: Timing of Unit	201.433	2	100.717	4.735	.011
Teaching Approach	200.856	1	200.856	9.442	.003
	23.445	1	23.445	1.102	.296
2-Way Interaction:	392.344	1	392.344	8.444	.001
Explained	971.604	4	242.901	1.419	.001
Residual	2382.515	112	21.272		
Total	3354.120	116	28.915		

Students who received the problem solving unit of instruction first in the series had a higher average achievement score on posttest #1 (28.53) than students who received the instructional unit first with a subject matter approach (25.69). Students who received the unit taught with the problem solving approach second in the instructional series had a lower average achievement score on posttest #1 (23.17) than students who received the unit taught in the subject matter approach second

(27.79) (Figure 4).

Figure 4

Posttest #1 Scores for Students Who Completed the "Preparing Beef Cattle for Show" Instructional Unit



The average student score on posttest #2 for students completing the "Preparing Beef Cattle for Show" instructional unit was 27.17, 21.75, 23.92, and 26.11 for students completing the unit first with the problem solving approach, completing the unit second with the problem solving approach, completing the unit first with the subject matter approach, and completing the unit second with the subject matter approach respectively (Table 13).

Table 13

Average Posttest #2 Scores of Students Completing the  
"Preparing Beef Cattle for Show" Instructional Unit

Approach	Timing of Unit of Instruction		
	First	Second	Total
Problem Solving	27.17 n=47	21.75 n=28	25.15 n=75
Subject Matter	23.92 n=13	26.11 n=27	25.40 n=40
Average Both Approaches	26.47 n=60	23.89 n=55	25.23 n=115

The analysis of covariance procedure (Table 14) produced a significant main effect of timing of the unit ( $p < .05$ ) and a significant two way interaction ( $p < .05$ ). Because the interaction is significant the significant main effect will not be discussed.

Students who received the "Preparing Beef Cattle for Show" (Figure 5) instructional unit first with the problem solving approach had a higher average achievement score on posttest #2 (27.17) than student who were taught the unit first with the subject matter approach (23.92). Students who received the "Preparing

Table 14

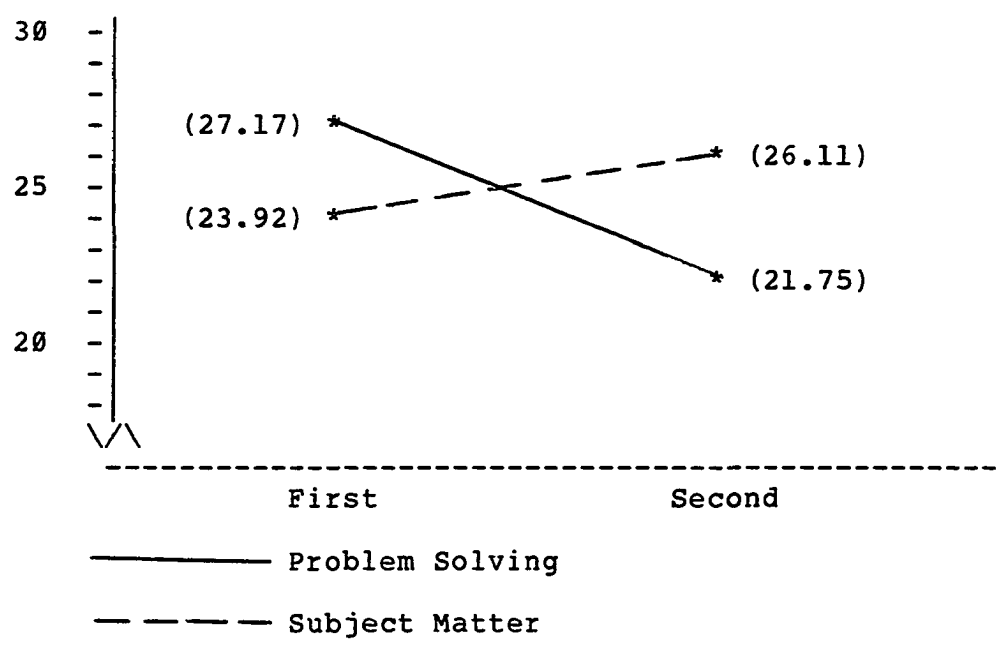
Analysis of Variance Comparing Posttest #2  
Scores of Students Completing the  
"Preparing Beef Cattle for Show" Instructional Unit

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Covariate:					
Pretest	424.653	1	424.653	11.129	.001
Main Effects:					
Timing of Unit	204.372	2	102.186	2.678	.073
Teaching Approach	202.981	1	202.981	5.319	.023
2-Way Interaction	8.899	1	8.899	.233	.630
Explained	420.176	1	420.176	11.011	.001
Residual	1049.201	4	262.300	6.874	.001
Total	4197.460	110	38.159		
	5246.661	114	46.023		

Beef Cattle for Show" instructional unit second with the problem solving approach had a lower average achievement score on posttest #2 (21.75) than students who were taught the unit second with the subject matter approach (26.11). Interaction patterns are similar for both posttest #1 and posttest #2 (Figures 4 and 5).

Figure 5

Posttest #2 Scores for Students Who Completed the "Preparing Beef Cattle for Show" Instructional Unit



The data from the "Controlling Weeds in Corn" instructional unit were analyzed using an analysis of covariance with the two independent variables, posttest #1 and posttest #2, treated as univariate dependent variables. An analysis and summary of the data follows.

The average achievement scores on posttest #1 (Table 15) for students completing the "Controlling Weeds in Corn" unit of instruction were 26.91, 23.93, 26.46, and 25.26 for students completing the unit first with the problem solving approach, completing the unit

second with the problem solving approach, completing the unit first with the subject matter approach, and completing the unit second with the subject matter approach respectively. An analysis of covariance revealed no significant main effects or interactions for posttest #1 scores on the "Controlling Weeds in Corn" unit (Table 16).

The average achievement scores on posttest #2 (Table 17) for students completing the "Controlling Weeds in Corn" instructional unit were 28.19, 20.32, 20.32, and 23.32 for students completing the unit first with the problem solving approach, completing the unit second with the problem solving approach, completing the

Table 15

Average Posttest #1 Scores for Students Completing the "Controlling Weeds in Corn" Instructional Unit

Approach	Timing of Unit of Instruction		
	First	Second	Total
Problem Solving	26.91 n=32	26.46 n=13	26.78 n=45
Subject Matter	23.93 n=29	25.26 n=47	24.75 n=76
Average Both Approaches	25.49 n=61	25.52 n=60	25.50 n=121



Table 16

Analysis of Covariance Comparing  
Average Posttest #1 Scores for Students Completing  
the "Controlling Weeds in Corn" Instructional Unit

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Covariate:					
Pretest	1227.128	1	1227.128	45.181	.001
Main Effects:					
Timing of Unit Teaching Approach	76.986	2	38.493	1.417	.247
	76.152	1	76.152	2.804	.097
	10.647	1	10.647	.392	.532
2-Way Interaction:					
	9.549	1	9.549	.352	.554
Explained	1313.663	4	328.416	12.092	.001
Residual	3150.585	16	27.160		
Total	4464.248	20	37.202		

unit first with the subject matter approach, and completing the unit second with the subject matter approach respectively. An analysis of covariance produced no significant main effects or interactions in the data recorded for posttest #2 scores on the "Controlling Weeds in Corn" unit (Table 18).

Table 17

Average Posttest #2 Scores for Students Completing  
the "Controlling Weeds in Corn" Instructional Unit

Approach	Timing of Unit of Instruction		
	First	Second	Total
Problem Solving	28.19 n=27	20.32 n=13	26.20 n=40
Subject Matter	20.32 n=28	23.32 n=47	22.20 n=75
Average Both Approaches	24.18 n=55	23.05 n=60	23.59 n=115

Table 18

Analysis of Covariance Comparing Average  
Posttest #2 Scores for Students Completing the  
"Controlling Weeds in Corn" Instructional Unit

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Covariate: Pretest	2250.096	1	2250.096	50.012	.001
Main Effects: Timing of Unit Teaching Approach	110.686 53.999 82.061	2 1 1	55.343 53.999 82.061	1.230 1.200 1.824	.296 .276 .180
2-Way Interaction:	156.032	1	156.032	3.468	.065
Explained	2516.814	4	629.203	13.985	.001
Residual	4949.978	110	44.991		
Total	7465.791	114	65.489		

### Multivariate Analysis of Covariance Results

Multivariate analysis of covariance statistical procedures were performed. Students' scores on posttest # 1 and posttest #2 were treated as the two dependent variables; timing of the unit and teaching approach were the independent variables, and the student's score on the pretest was the covariate for the analysis. There were two levels of the independent variable timing of the unit (first or second in the instructional series) and two levels of teaching approach (problem solving and subject matter). Separate analyses were performed for the "Preparing Beef Cattle for Show" and "Controlling Weeds in Corn" instructional unit data.

Mean scores and standard deviations for pretests, posttest #1 and posttest #2 of the "Preparing Beef Cattle for Show" Unit are reported in Table 19. The entire population gained an average of 5.89 points from the pretest to posttest #1. The population lost an average of 1.54 points from posttest #1 to posttest #2. The students who received instruction via a problem solving approach gained an average of 6.13 points from the pretest to posttest #1 and dropped an average of 1.50 points from posttest #1 to posttest #2. These figures compared with a 5.43 point increase from pretest to posttest #1 for students who received instruction via

a subject matter approach. The students who received instruction via a subject matter approach had an average decrease of 1.63 point decrease from posttest #1 to posttest #2.

The multivariate analysis of covariance (Table 20) showed a significant interaction ( $p < .05$ ) between timing of instruction and teaching approach used. When "Preparing Beef Cattle for Show" was the first of the two units of instruction taught, students taught by the problem solving approach achieved higher scores on both posttest #1 and posttest #2 than students taught by the subject matter approach. When the "Preparing Beef Cattle for Show" unit was the second of the two units taught, students taught the problem solving approach achieved lower scores on both posttests than students taught by the subject matter approach.

Students who received the "Controlling Weeds in Corn" instructional unit with a problem solving approach to instruction improved their achievement scores by an average of 5 points from the pretest to posttest #1 (Table 21). The students had an average decrease in achievement scores of .7 from posttest #1 to posttest #2. Students who were taught the unit with a subject matter approach had an average increase of 6.05 points from the pretest to posttest #1. The decrease between

Table 19

Average Pretest and Posttest Scores for Students  
Completing the "Preparing Beef Cattle for Show"  
Instructional Unit

Approach and Time	Pretest	Posttest #1	Posttest #2
Problem Solving First	20.362 sd=4.136 n=47	28.532 sd=4.333 n=47	27.170 sd=6.455 n=47
Problem Solving Second	20.750 sd=4.680 n=28	23.464 sd=4.655 n=28	21.750 sd=6.456 n=28
Problem Solving Total	20.507 sd=4.320 n=75	26.640 sd=5.066 n=75	25.147 sd=6.933 n=75
Subject Matter First	22.615 sd=2.959 n=13	25.692 sd=7.181 n=13	23.923 sd=7.729 n=13
Subject Matter Second	21.111 sd=4.972 n=27	27.667 sd=4.969 n=27	26.111 sd=5.976 n=27
Subject Matter Total	21.600 sd=4.372 n=40	27.025 sd=5.762 n=40	25.400 sd=6.578 n=40
Timing of Unit First Total	20.850 sd=3.999 n=60	27.917 sd=5.150 n=60	26.467 sd=6.816 n=60
Timing of Unit Second Total	20.927 sd=4.784 n=55	25.527 sd=5.217 n=55	23.891 sd=6.548 n=55
Average for Entire Population	20.887 sd=4.372 n=115	26.774 sd=5.297 n=115	25.235 sd=6.784 n=115

Table 20

Multivariate Analysis of Covariance Comparing Average Posttest Scores of Students Completing the "Preparing Beef Cattle for Show" Instructional Unit

Source of Variation	Wilks Lambda	Exact F	Hypoth DF	Error DF	P
Within Cells Regression	.83989	10.38936	2.00	109.00	.001
2 Way Interaction	.84944	9.65993	2.00	109.00	.001
Teaching Approach	.99965	.01904	2.00	109.00	.981
Timing of Unit	.98092	1.05990	2.00	109.00	.350

posttest #1 and posttest #2 was 2.68 points. The population average was a 5.69 point increase from pretest to posttest #1 and a 1.99 point decrease from posttest #1 to posttest #2.

The multivariate analysis of covariance (Table 22) did not show any significant main effects or interaction for student completing the "Controlling Weeds in Corn" instructional unit. When "Controlling Weeds in Corn" was the first of the two units of instruction taught, students taught by the problem solving approach did not achieve higher scores on both posttest #1 and posttest #2 than students taught by the subject matter approach. When the "Controlling Weeds in Corn" unit was the second

Table 21

Average Pretest and Posttest Scores of Students Completing  
the "Controlling Weeds in Corn" Instructional Unit

Approach and Time	Pretest	Posttest #1	Posttest #2
Problem Solving First	23.556 sd=3.856 n=27	27.111 sd=3.490 n=27	28.185 sd=2.829 n=27
Problem Solving Second	18.462 sd=5.753 n=13	26.462 sd=5.238 n=13	22.077 sd=9.420 n=13
Problem Solving Total	21.900 sd=5.093 n=40	26.900 sd=4.081 n=40	26.200 sd=6.406 n=40
Subject Matter First	18.929 sd=5.422 n=28	24.250 sd=7.011 n=28	20.321 sd=8.446 n=28
Subject Matter Second	18.766 sd=4.957 n=47	25.255 sd=6.784 n=47	23.319 sd=8.552 n=47
Subject Matter Total	18.827 sd=5.100 n=75	24.880 sd=6.840 n=75	22.200 sd=8.580 n=75
Timing of Unit First Total	21.200 sd=5.226 n=55	25.655 sd=5.703 n=55	24.182 sd=7.434 n=55
Timing of Unit Second Total	18.700 sd=5.090 n=60	25.517 sd=6.458 n=60	23.050 sd=8.680 n=60
Average for Entire Population	19.896 sd=5.284 n=115	25.583 sd=6.083 n=115	23.591 sd=8.093 n=115

of the two units taught, students taught the problem solving approach did not achieve lower scores on both posttests than students taught by the subject matter approach.

Table 22

Multivariate Analysis of Covariance Comparing Average Posttest Scores of Students Completing the "Controlling Weeds in Corn" Instructional Unit

Source of Variation	Wilks Lambda	Exact F	Hypoth DF	Error DF	P
Within Cells Regression	.63040	31.95279	2.00	109.00	.001
2 Way Interaction	.96290	2.09996	2.00	109.00	.127
Teaching Approach	.98587	.78122	2.00	109.00	.460
Timing of Unit	.97697	1.28463	2.00	109.00	.281

Multivariate Analysis of Covariance with Repeated Measures and Two Independent Variables

The final analysis of the data was accomplished with multivariate analysis of covariance with repeated measures and two independent variables. The independent variables were timing of the unit and teaching approach. The covariate was students pretest scores. Separate analyses were performed on data compiled from the "Preparing Beef Cattle for Show" and Controlling Weeds in Corn" instructional units. The two dependent



variables (repeated measures) were student achievement scores on posttest #1 and posttest #2. The MANCOVA procedure converted the two repeated dependent variables into a new single adjusted dependent variable. The new dependent variable for the "Preparing Beef Cattle for Show" instructional unit is BFTPOST. The new dependent variable for the "Controlling Weeds in Corn" instructional unit is WDTPOST. The adjusted mean scores are reported in Tables 23 and 24.

The adjusted mean scores (table 23) for students completing the "Preparing Beef Cattle for Show" unit of instruction were 39.92, 34.19, 32.26, and 38.09 for students who completed the unit first with the problem solving approach to teaching, students who completed the unit first with a subject matter approach, students who completed the unit second with the problem solving approach to teaching, and students who completed the unit second with a subject matter approach respectively.

Table 23

Adjusted Mean Posttest Scores for Students Completing the "Preparing Beef Cattle for Show" Unit of Instruction

Approach	Timing of Unit of Instruction		
	First	Second	Total
Problem Solving	39.92	32.26	36.09
Subject Matter	34.19	38.09	36.14
Average Both Approaches	37.06	35.17	

The adjusted mean scores (Table 24) for students completing instruction in the "Controlling Weeds in Corn" unit were 35.53, 32.49, 35.76, and 35.09 for students who completed the unit first with the problem solving approach to teaching, students who completed the unit first with a subject matter approach, students who completed the unit second with the problem solving approach to teaching, and students who completed the unit second with a subject matter approach respectively.

Table 24

Adjusted Mean Posttest Scores for Students Completing  
the "Controlling Weeds in Corn" Instructional Unit

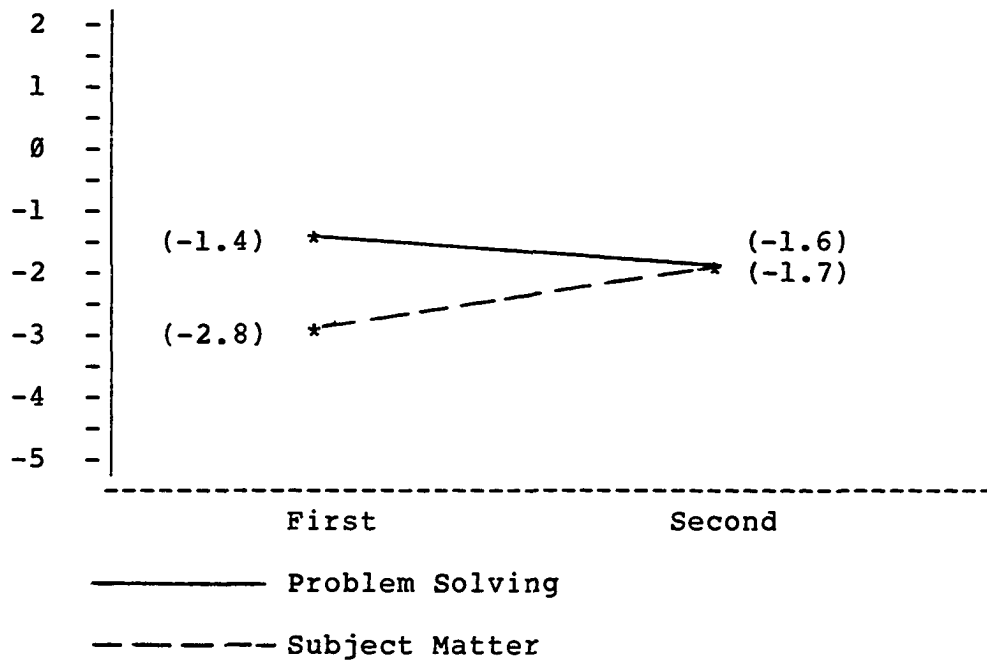
Approach	Timing of Unit of Instruction		
	First	Second	Total
Problem Solving	35.53	35.76	35.65
Subject Matter	32.49	35.49	33.99
Average Both Approaches	34.02	35.63	

The multivariate analysis of covariance procedure (Table 25) produced a significant effect on the dependent variable BFTPOST which indicated a significant difference between scores on posttest #1 and posttest #2 for students completing the "Preparing Beef Cattle for Show" instructional unit. Scores on posttest #1 were significantly higher than scores on posttest #2 for the "Preparing Beef Cattle for Show" instructional unit (Figure 6).

The multivariate analysis of covariance with repeated measures procedure (Table 25) produced a significant interaction between the independent variables in the "Preparing Beef Cattle for Show" unit data. Students taught the unit first with a problem

Figure 6

Comparison of Differences Between Posttest for  
Students Completing the  
"Preparing Beef Cattle for Show" Instructional Unit



solving approach (Figure 7) had a higher adjusted mean score (39.92) than students taught the unit first with a subject matter approach (34.19). Students taught the unit second in an instructional series with a problem solving approach had a lower adjusted mean score (32.26) than students taught the unit second with a subject matter approach (38.09).

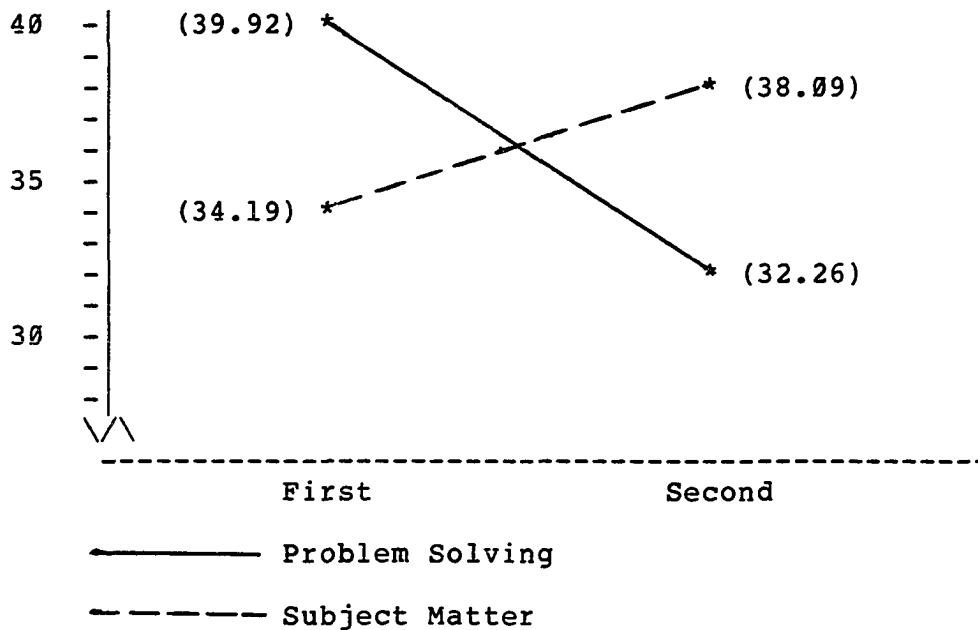
Table 25

Multivariate Analysis of Covariance with Repeated Measures  
 Comparing Adjusted Student Scores on the  
 "Preparing Beef Cattle for Show" Instructional Unit

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Within Cells	4659.01	110	42.35		
Regression	851.14	1	851.14	20.10	.001
Constant	2317.42	1	2317.42	54.71	.001
Timing of Unit	82.71	1	82.71	1.95	.165
Teaching Approach	.05	1	.05	.00	.972
Timing x Approach	773.65	1	773.65	18.27	.001
Within Cells	1886.77	111	17.00		
BFTPOST	119.83	1	119.83	7.05	.009
Timing of Unit x BFTPOST	.06	1	.06	.00	.954
Approach x BFTPOST	.18	1	.18	.01	.918
Timing x Approach	.94	1	.94	.06	.815

Figure 7

Comparison of Adjusted Student Scores on the  
 "Preparing Beef Cattle for Show" Instructional Unit

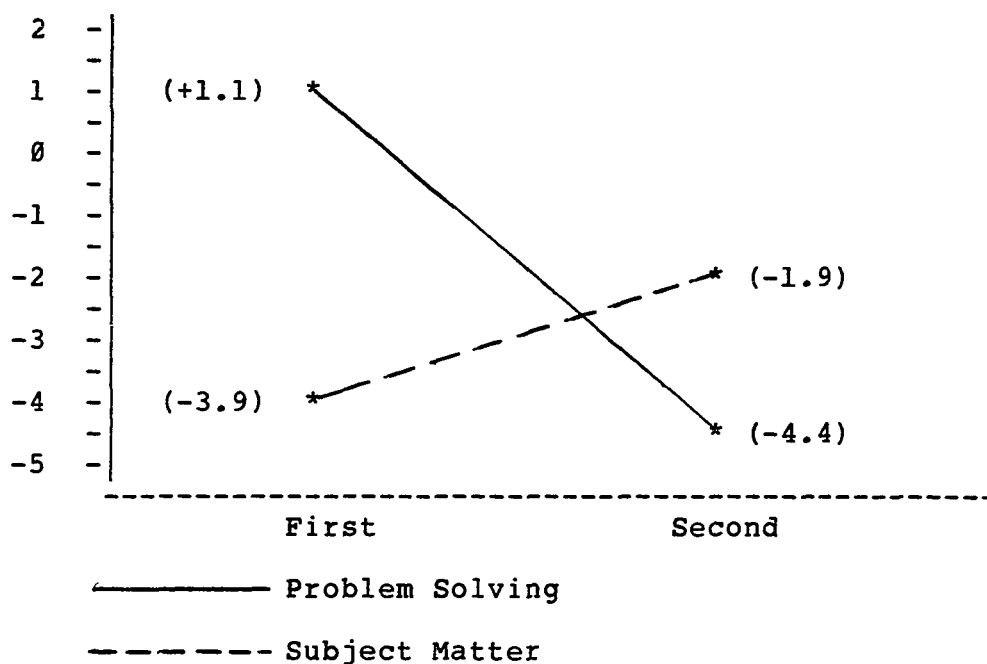


The multivariate analysis of covariance procedure produced a significant effect on the dependent variable WDTPOST which indicated a significant difference between scores on posttest #1 and posttest #2 for students completing the "Controlling Weeds in Corn" instructional unit. In addition to the significant effect of the adjusted dependent variable, WDTPOST, there was a significant interaction of timing of the instructional unit (first or second) and approach to teaching (problem solving and subject matter) on the variable WDTPOST.

When "Controlling Weeds in Corn" (Figure 8) was the first of the two units of instruction taught, students taught by the problem solving approach had higher achievement scores (+1.07) on posttest #2 than students taught first by the subject matter approach (-3.9). Students taught first with a problem solving approach increased 1.07 points from the completion of posttest #1 to the completion of posttest #2 while students taught first with a subject matter approach decreased 3.9 points from the completion of posttest #1 to the completion of posttest #2. When the "Controlling Weeds in Corn" unit was the second of the two units taught, students taught the problem solving approach achieved lower retention scores (-4.40) on posttest #2 than students taught by the subject matter approach (-1.9) (Figure 8).

Figure 8

Comparison of Differences Between Posttest for  
Students Completing the  
"Controlling Weeds in Corn" Instructional Unit



The multivariate analysis of covariance with repeated measures procedure (Table 26 and Figure 9) did not produce a significant interaction or main effect of the approach to teaching or timing of the unit in the instructional series in the "Controlling Weeds in Corn" unit data.



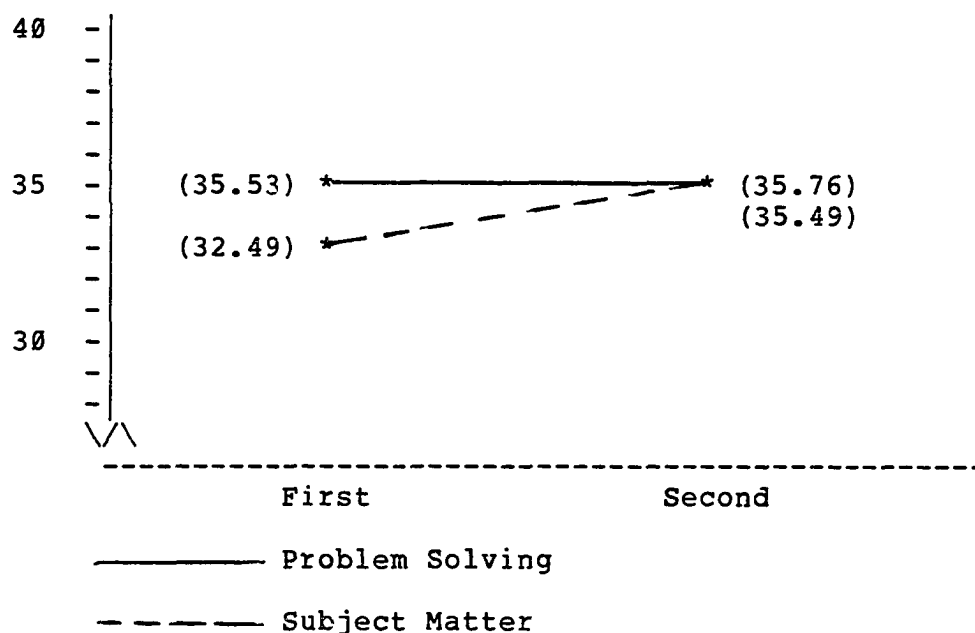
Table 26

Multivariate Analysis of Covariance with Repeated Measures  
 Comparing Adjusted Student Scores on the  
 "Controlling Weeds in Corn" Instructional Unit

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Within Cells	4520.18	110	41.09		
Regression	2615.43	1	2615.43	63.65	.001
Constant	1475.91	1	1475.91	35.92	.001
Timing of Unit	57.16	1	57.16	1.39	.241
Teaching Approach	61.61	1	61.61	1.50	.223
Timing x Approach	42.42	1	42.42	1.03	.312
Within Cells	3517.80	111	31.69		
WDTPOST	246.23	1	246.23	7.77	.006
Timing of Unit x WDTPOST	35.14	1	35.14	1.11	.295
Approach x WDTPOST	19.08	1	19.08	.60	.439
Timing x Approach	162.38	1	162.38	5.12	.026

Figure 9

Comparison of Adjusted Student Scores on the  
"Controlling Weeds in Corn" Instructional Unit



#### Instructional Time for Units

The minutes of instructional time required to teach each unit of instruction were recorded in the teachers daily log. Comparisons were made on the amount of time necessary to complete the units using a one way analysis of variance.

The average number of minutes necessary to complete the "Preparing Beef Cattle for Show" was 200.33 and 117.00 for problem solving and subject matter respectively. The average number of instructional

minutes needed to complete the Controlling Weeds in Corn" unit was 150.00 and 196.67 for problem solving and subject matter approaches respectively (Table 27).

Table 27

Average Instructional Time Needed to Complete to Teach Units in "Preparing Beef Cattle for Show" and "Controlling Weeds in Corn" Using a Problem Solving and Subject Matter Approaches

Unit	Instruction Time in Minutes	
	Problem Solving	Subject Matter
"Preparing Beef"	200.33	117.00
"Controlling Weeds"	150.00	196.67
Total Both Units	187.75	176.75

An analysis of variance comparing the number of minutes of instructional time revealed no significant difference between the time necessary to teach either unit with a problem solving approach or a subject matter approach.

Table 28

Analysis of Variance Comparing the Average  
Instructional Time Needed to Teach the  
"Preparing Beef Cattle for Show" Instructional Unit

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects:					
Teaching Approach	5208.333	1	5208.333	1.2827	>.25
Residual	8120.667	2	4060.333		
Total	13329	3			

Table 29

Analysis of Variance Comparing the Average  
Instructional Time Needed to Teach the  
"Controlling Weeds in Corn" Instructional Unit

Source of Variation	Sum of Squares	DF	Mean Square	F	P
Main Effects:					
Teaching Approach	1633.333	1	1633.333	.1709	>.25
Residual	19116.667	2	9558.333		
Total	20750	3			

### Summary

Analysis of the data produced a significant effect of timing of the unit and teaching approach on student attitudes toward the instruction. The main effects of

timing of the unit and teaching approach could not be fully interpreted because of a significant interaction between timing of the unit and teaching approach.

The multivariate analysis of covariance with repeated measures showed no significant main effects of timing of unit and teaching approach on student achievement. There was a significant interaction in the "Preparing Beef Cattle for Show" data between the two independent variables, timing of instruction (first or second) and approach to teaching (problem solving or subject matter). When "Preparing Beef Cattle for Show" was the first of the two units of instruction taught, students taught by the problem solving approach achieved higher scores on both posttest #1 and posttest #2 than students taught by the subject matter approach. When the "Preparing Beef Cattle for Show" unit was the second of the two units taught, students taught the problem solving approach achieved lower scores on both posttests than students taught by the subject matter approach.

The analysis of the audio tapes produced evidence to help explain the absence of any significant main effects of timing of unit and approach to teaching. The

mean difference between the adjusted scores of teachers using the two approaches was 1.18. Two teachers failed to use the prescribed problem solving approach in their instruction. The results of the treatments not being administered properly probably had a significant effect upon the results of the study.

## CHAPTER V

### SUMMARY, CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

#### Purpose of the Study

The purpose of this study was to determine which approach, problem solving or subject matter, was the most effective in teaching high school vocational agriculture students.

The objectives of this study are reflected by the following research questions:

1. Which approach to teaching (problem solving or subject matter) will result in higher student achievement on a given unit of instruction in vocational agriculture?
2. Will there be a difference in student retention of knowledge between students taught with a subject matter approach and students taught with a problem solving approach?
3. Which approach to teaching (problem solving or subject matter) will require the greater amount of instructional time to complete a given unit of instruction in vocational agriculture.
4. Will there be a difference in student attitudes toward the instruction as a result of being taught with a problem solving approach as opposed to a subject matter approach as measured on a 15 item Likert scale attitude instrument.

#### Procedure

This data for this study were collected using a quasi-experimental counterbalance design study. The

target population was all students enrolled in vocational agriculture in Ohio. The accessible population was 121 freshmen students enrolled in production agriculture in seven Ohio comprehensive high schools.

Data analysis for student achievement was accomplished with several procedures: univariate analysis of covariance, multivariate analysis of covariance and multivariate analysis of covariance with repeated measures. The only statistical procedure used for conclusions and recommendations was multivariate analysis of covariance with repeated measures that included both independent variables.

#### Summary of Findings and Conclusions

##### Attitude Toward Instruction

An analysis of variance was used to determine if there was a significant difference between mean attitude scores for students who completed instructional units with a problem solving approach and students who completed an instructional unit with a subject matter approach. Results of the analysis of variance indicated a significant interaction between the two independent variables effects on student's attitude toward instruction scores. Students taught an instructional unit first with a problem solving



approach had higher mean attitude toward instruction score than students taught the unit first with a subject matter approach. Students taught an instructional unit with a problem solving approach second in an instructional series had lower mean attitude scores than students taught the unit second with a subject matter approach.

#### Instructional Time Necessary to Complete Units

There was no significant difference in the time necessary to complete an instructional unit with a problem solving approach compared to the time necessary to complete an instructional unit with a subject matter approach. The two unit plans were planned with equal instructional material in them. the only differences were to accommodate the two teaching approaches used in the study.

#### Student Achievement and Retention

The data were analyzed using several univariate methods of analysis. The final analysis performed on the data was multivariate analysis of covariance with repeated measures. The results of the multivariate analysis of covariance with repeated measures produced no significant main effects of timing of the unit or teaching approach used.

A significant interaction was found for students completing the "Preparing Beef Cattle for Show" instructional unit. Students taught the unit first with the problem solving approach had higher adjusted achievement scores than students taught the unit first with a subject matter approach. Students taught the unit second with the problem solving approach had lower adjusted achievement scores than students completing the unit second with a subject matter approach.

#### Teaching Approach Score

Each teacher was requested to audio tape all instruction conducted for the study. The audio tapes were used to verify the treatment students received as a result of the instructional units used in the study. All tapes were analyzed and given an adjusted teaching method score. Two of the six teachers did not teach problem solving instructional units with a problem solving approach. Four teachers used variations of the problem solving approach in their subject matter approach units. The results of this were adjusted scores that varied 1.18 units on a seven point scale from instruction used in problem solving to instruction used in the subject matter approach. Teachers either did not use the problem solving

approach or their variations of the the two approaches were so small that there was limited opportunity for variable input on student achievement scores.

### Conclusions

After careful analysis of the data from the study, the researcher offers the following conclusions:

1. After analyzing of the audio tapes of the teachers' instruction, the researcher concluded that the levels of the independent variable, teaching approach, were not administered properly in the study.
2. Teachers who use problem solving instruction on a regular basis in the classroom have a difficult time using the subject matter approach.
3. Teachers do not fully use all of the essential elements of the problem solving approach to teaching.
4. Student attitude toward instruction was influenced by both timing of the unit and instructional approach used by teachers in the study. Students taught with the problem solving approach first in an instructional series have higher a attitude toward the instruction than students taught first with a subject matter approach. Students taught

with a subject matter approach second in an instructional series have higher a attitude toward instruction than did students taught second with a problem solving approach.

5. The timing of the unit and the instructional approach had a significant effect upon student achievement scores. Students taught with the problem solving approach first in an instructional series have higher achievement scores than students taught first with a subject matter approach. Students taught with a subject matter approach second in an instructional series had a higher achievement scores than did students taught second with a problem solving approach.
6. The problem solving approach to teaching and the subject matter approach to teaching require the same amount of classroom time to complete an instructional unit.
7. The group of teachers recognized by state supervisors and teacher educators as users of problem solving is not accurate. Thirty-three percent (n=2) of the teachers in the study that submitted audio tapes did not use the problem solving approach on the prescribed unit.

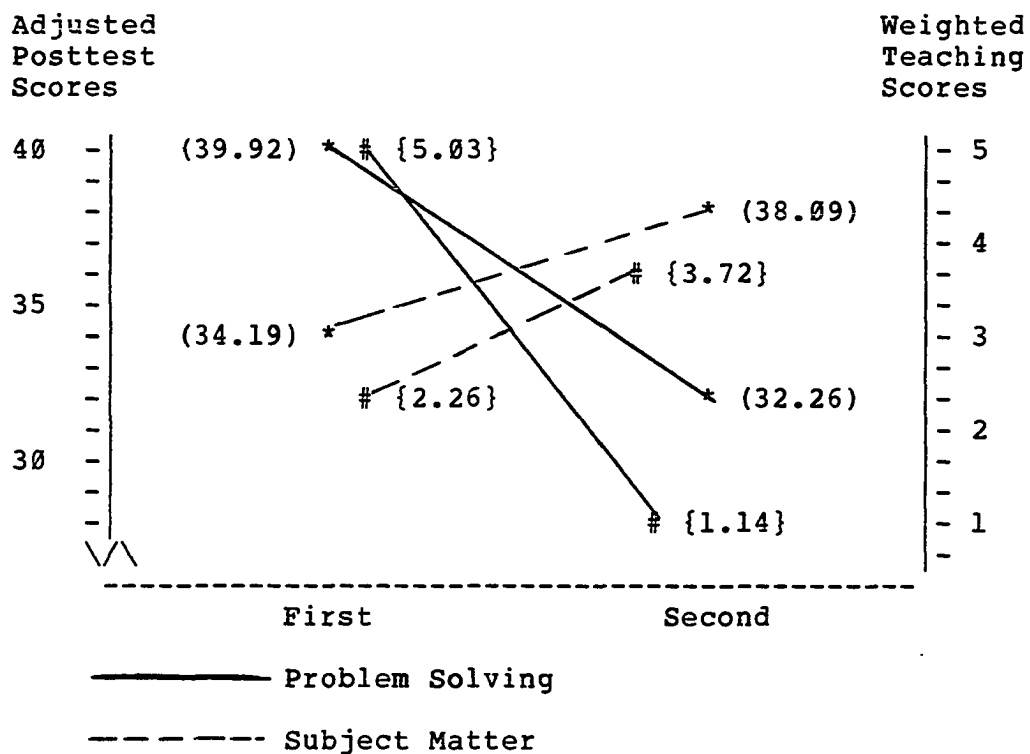
### Discussion

The implications of the data presented in this study indicate that the effectiveness of problem solving was not adequately measured. If the statistical analysis had been limited to attitude and achievement data of students completing the "Preparing Beef Cattle for Show" and "Controlling Weeds in Corn" instructional units, it would appear that there was no difference in student achievement and attitudes scores between students taught with a problem solving approach and those students taught with a subject matter approach. Verification of the treatment was conducted with the use of audio tapes. The adjusted teaching scores that were produced as a result of the verification of treatment indicated that there was little difference between the two approaches used by the teachers participating in the study. Teachers in the study performed in one of two ways. Two teachers did not use the problem solving approach to teach the instructional unit designated by the researcher for the problem solving approach. The other four teachers incorporated many features of a problem solving approach in their instructional unit designated by the researcher to be taught with a subject matter approach. The result was variance in the levels of

the independent variable, approach to teaching, was not maximized. The failure to follow prescribed levels of the independent variable could explain the significant interactions between timing of the instructional unit and teaching approach (Figure 9).

Figure 10

Comparison of Adjusted Student Scores and Weighted Teaching Scores on the "Preparing Beef Cattle for Show" Instructional Unit



What are the real benefits of the problem solving approach? Achievements test scores based upon an

immediate posttest and a follow-up posttest score two weeks later were used to judge the effects of the two teaching approaches on student achievement. Are the real benefits of problem solving noticeable in an achievement test? One of the real benefits of the problem solving approach to teaching may be that it is a method of learning students can use both inside and outside of a classroom. Another aspect of problem solving is the transfer of knowledge from a known situation to one that is unknown. Achievement tests, such as the ones used in this study, cannot measure this aspect of the problem solving approach to teaching.

The teachers in this study had a difficult time using an instructional approach with which they were not familiar. The unit plans were written in such a way that the instructional approaches should have been easy to follow. Once teachers were in the classroom, they soon reverted to using their traditional style of teaching. They either used the subject matter (lecture) approach they were used to using or they incorporated portions of the problem solving approach in their subject matter approach instruction. Can this be corrected with proper training in both approaches or will a teacher always revert to what is most comfortable when they encounter the heat of the classroom "battle."

Teachers can receive help with their instruction through proper supervision and feedback from superintendents, principals, teacher educators, and teaching supervisors. These individuals can assist the teacher in learning the different aspects of both approaches and point out when a teacher inadvertently switches from one approach to the other.

Even though four of the six teachers who provided audio tapes used a form of the problem solving approach to teaching, are teachers using all of the essential elements of problem solving instruction with their students? The adjusted teaching approach scores for the four teachers' problem solving approach units ranged from 4.26 to 5.68 on a seven point scale. The researcher had established a minimum score of four to be considered problem solving teaching. Will a teaching performance that has an adjusted teaching score between four and six give the students the full benefit of the problem solving approach to teaching? Should the adjusted teaching approach score be a seven on a seven point scale to be considered problem solving and provide the maximum learning opportunities for students participating in the instructional unit?



### Recommendations

The writer makes the following recommendations for research in the area of the effectiveness of the problem solving approach to teaching:

1. The effectiveness of teaching approaches must continue to be studied. Every effort must be made to eliminate contaminating variables from the study.
2. Teachers who participate in the study must be trained with inservice education prior to participating in the study. This will make it possible for the researcher to communicate exactly how the units are to be taught and provide for instruction in the teaching approaches to be used.
3. The participants in the study should be monitored carefully. Expenses are always a consideration but every effort should be taken to monitor and evaluate the teaching performance of teachers participating in such a study.
4. Every effort must be taken to maximize the variance in the levels of the independent variable. To accomplish this the researcher must make every effort to insure that teachers use subject matter and problem solving approach

instructional procedures when they are prescribed in the research design.

5. The effects of a problem solving approach must be studied and the researcher should design the study to accurately measure the true effects of a problem solving approach.
6. The researcher found teachers incorporating aspects of the problem solving approach in their subject matter instruction. Addition research should be conducted to determine if the components of the problem solving approach incorporated in the subject matter instruction are a result of the teachers' knowledge of the psychological aspects of teaching and learning and not simply components of the problem solving approach to teaching.
7. An example of the pure form of the problem solving approach was not found in the study. Inservice education should be provided that will help all teachers better use the true problem solving approach.

**APPENDIX A**  
**LETTER OF INTRODUCTION**



Department of Agricultural  
Education

208 Agricultural  
Administration Building  
2120 Fyffe Road  
Columbus, OH 43210-1099  
Phone 614-292-6321

114

March 7, 1988

Sam Custer  
Versailles High School  
459 South Center Street  
Versailles, OH 45380

Dear Sam,

For years most of us in agricultural education have extolled the values of various approaches to teaching. Often we find that our arguments are based more on traditions than empirical evidence. Maybe good teachers are effective regardless of how they teach. Your Department of Agricultural Education must be committed to discovering the answers to this type of question.

As a part of a very important study we are planning, we need your help. We do hope you will give us a hand in discovering new knowledge.

If you agree to help us, the study will be conducted using one section of your Vo-Ag I students. We will need for you to teach two instructional units to the class, each lasting approximately five days. One unit will be taught using the problem solving approach and the other unit will be taught with a subject matter approach. A pretest will be administered at the start of each unit, a posttest will be given immediately following the completion of the unit, and a second posttest will be given two weeks after the completion of the unit. We will need for you to record all class sessions using audio cassette tapes which we will provide. We will prepare all unit plans, tests, and score all tests. We will provide copies of the tests, and postage to cover the return of the tapes and tests. A copy of the results of the tests and a summary of the study will be provided to you.

On the enclosed card, will you provide a list of six units that you plan to teach your freshmen students in the next two months? We will take the list and attempt to develop the two units of instruction that best fit all teachers schedules.

Your participation in the study is essential for the success of the study. The results of this study will have an impact on vocational agriculture instruction in the State of Ohio and the nation. Your participation will benefit students today and in the future. You will be contacted by phone in the next few days to determine if you have any questions. Please return the postcard with the appropriate information as soon as possible.

We sincerely appreciate your consideration of this important request.

Thank you,

Harry Boone, Graduate Student  
Department of Agricultural Education

Dr. L. H. Newcomb, Professor and Chair  
Department of Agricultural Education

**APPENDIX B**

**REPLY CARD**

NAME \_\_\_\_\_

SCHOOL \_\_\_\_\_

SCHOOL ADDRESS \_\_\_\_\_  
street post office zip code

HOME ADDRESS \_\_\_\_\_  
street post office zip code

SCHOOL PHONE \_\_\_\_\_ HOME PHONE \_\_\_\_\_

Please list six units of instruction you plan to cover  
with your freshmen students this school year.

1. \_\_\_\_\_ 4. \_\_\_\_\_

2. \_\_\_\_\_ 5. \_\_\_\_\_

3. \_\_\_\_\_ 6. \_\_\_\_\_

NUMBER OF FRESHMEN STUDENTS \_\_\_\_\_

**APPENDIX C**  
**LETTER OF PARTICIPATION IN STUDY**





Department of Agricultural  
Education

208 Agricultural  
Administration Building  
2120 Fyffe Road  
Columbus, OH 43210-1099  
Phone 614-292-6321

119

April 11, 1988

Sam Custer  
Versailles High School  
459 South Center Street  
Versailles, OH 45380

Dear Sam,

Two weeks ago your assistance was requested on a very important research study that I am conducting in cooperation with the Agricultural Education Department at The Ohio State University. The study will evaluate the problem solving and subject matter approaches to teaching on student achievement.

I would like to thank you for returning the information requested and agreeing to participate in the study. I tried to keep everyone's suggestions for instructional units in mind when "Weed Control in Corn" and "Preparing Beef Cattle for Show" were selected as the instructional units for the study. If the instructional units do not exactly match your course of study, or if you have taught the units before, your assistance is still needed for the study. The instruments used to measure student achievement will compensate for the situation. Your assistance with the study is vital to the success of this research project. The success of the research project will have an impact on instructional methods used in Vocational Agriculture classes across the nation.

You will receive a package of information including instruction instructions, unit plans, pretests, posttest #1, posttest #2, and 14 blank cassette tapes before April 20, 1988. You can start teaching the units as soon as you receive the information but you should plan to start no later than April 25. The two units will take approximately 10 days to complete. Your teaching responsibilities should be completed no later than May 6. This would schedule the administration of the last posttest no later than May 20.

If you have any questions please contact me at 614-292-3421. Thank you for your assistance in this important research study.

Thank you,

Harry Boone, Graduate Student  
Department of Agricultural Education

L. H. Newcomb, Professor and Chair  
Department of Agricultural Education

**APPENDIX D**  
**LETTERS WITH MATERIALS FOR STUDY**



Department of Agricultural  
Education

208 Agricultural  
Administration Building  
2120 Fyffe Road  
Columbus, OH 43210-1099  
Phone 614-292-6321

April 18, 1988

Dear Sam,

We would like to thank you for taking time to participate in this very important research project. This mailing provides the information necessary to complete your part in the study.

You will begin with the "Preparing Beef Cattle for Show" unit. The following preparation will be needed to start this unit. There are four handouts and four tests that need to be copied for all students involved in the study. The four handouts will provide a work-sheet and three sets of reference material for the unit. There is a pretest, posttest #1, posttest #2, and an attitude test that will be administered to the student.

You will conclude with the "Controlling Weeds in Corn" unit. You will need to make some preparations for the beginning of this unit. There are three handouts and four tests that need to be copied for all students involved in the study. There are four overhead masters that you may wish to make into overhead transparencies. The three handouts will provide a work-sheet and two sets of reference material for the unit. There is a pretest, posttest #1, posttest #2, and an attitude test that will be administered to the student.

We have included fourteen cassette tapes to insure that the entire teaching time is recorded. A sample schedule may look something like this:

April	22	Make copies and prepare for "Beef" unit
April	25	Give students "Beef" pretest
April	25	Start teaching "Beef" unit
April	29	Conclude "Beef" unit
May	2	Give "Beef" posttest #1 and attitude measure
May	2	Make copies and prepare for "Weeds" unit

May	3	Give "Weeds" pretest
May	3	Start teaching "Weeds" unit
May	9	Conclude "Weeds" unit
May	10	Give "Weeds" posttest #1 and attitude measure
May	16	Administer "Weeds" posttest #2
May	24	Administer "Weeds" posttest #2

The schedule is only a suggestion. The time spent on each unit will depend upon your individual teaching style. Please follow the directions on the unit plans as closely as possible. The only requirement is that the second posttest will be administered two weeks (fourteen days) after the completion of the first posttest.

After the completion of the study please return to me the cassette tapes, and all tests completed by the students. We will score the tests and return a summary to you. We have enclosed an envelope with enough postage to insure that you will be able to mail the materials at no additional expense. If that is not the case please mail the materials and we will promptly refund your expenses.

In addition we need you to keep a diary of events that occur during the teaching of the two units. The diary will include the number of minutes taught each day and any unusual circumstances that disrupted your class schedule such as school assemblies, fire drills, etc.

Thank you very much for participating in the study. You have made a tremendous contribution to the knowledge about teaching and learning.

Sincerely yours,

Harry M. Boone Jr., Graduate Student

L. H. Newcomb, Professor and Chair  
Agricultural Education Department



Department of Agricultural  
Education

208 Agricultural  
Administration Building  
2120 Fyffe Road  
Columbus, OH 43210-1099  
Phone 614-292-6321

124

April 18, 1988

Dear Jim,

We would like to thank you for taking time to participate in this very important research project. This mailing provides the information necessary to complete your part in the study.

You will begin with the "Controlling Weeds in Corn" unit. You will need to make some preparations for the beginning of this unit. There are three handouts and four tests that need to be copied for all students involved in the study. There are four overhead masters that you may wish to make into overhead transparencies. The three handouts will provide a work-sheet and two sets of reference material for the unit. There is a pretest, posttest #1, posttest #2, and an attitude test that will be administered to the student.

You will conclude with the "Preparing Beef Cattle for Show" unit. The following preparation will be needed to start this unit. There are four handouts and four tests that need to be copied for all students involved in the study. The four handouts will provide a work-sheet and three sets of reference material for the unit. There is a pretest, posttest #1, posttest #2, and an attitude test that will be administered to the student.

We have included fourteen cassette tapes to insure that the entire teaching time is recorded. A sample schedule may look something like this:

April	22	Make copies and prepare for "Weeds" unit
April	25	Give students "Weeds" pretest
April	25	Start teaching "Weeds" unit
April	29	Conclude "Weeds" unit
May	2	Give "Weeds" posttest #1 and attitude measure
May	2	Make copies and prepare for "Beef" unit

May	3	Give "Beef" pretest
May	3	Start teaching "Beef" unit
May	9	Conclude "Beef" unit
May	10	Give "Beef" posttest #1 and attitude measure
May	16	Administer "Weeds" posttest #2
May	24	Administer "Beef" posttest #2

The schedule is only a suggestion. The time spent on each unit will depend upon your individual teaching style. Please follow the directions on the unit plans as closely as possible. The only requirement is that the second posttest will be administered two weeks (fourteen days) after the completion of the first posttest.

After the completion of the study please return to me the cassette tapes, and all tests completed by the students. We will score the tests and return a summary to you. We have enclosed an envelope with enough postage to insure that you will be able to mail the materials at no additional expense. If that is not the case please mail the materials and we will promptly refund your expenses.

In addition we need you to keep a diary of events that occur during the teaching of the two units. The diary will include the number of minutes taught each day and any unusual circumstances that disrupted your class schedule such as school assemblies, fire drills, etc.

Thank you very much for participating in the study. You have made a tremendous contribution to the knowledge about teaching and learning.

Sincerely yours,

Harry N. Boone Jr., Graduate Student

L. H. Newcomb, Professor and Chair  
Agricultural Education Department

**APPENDIX E**  
**TEACHER LOG #1 AND LOG #2**



## DIARY

TEACHER \_\_\_\_\_

UNIT	DATE	NUMBER MINUTES	CIRCUMSTANCES
Weeds Pretest			
Weeds Unit			
Weeds Unit			
Weeds Unit			
Weeds Unit			
Weeds Unit			
Posttest #1			
Posttest #2			
Pretest			
Beef Unit			
Beef Unit			
Beef Unit			
Beef Unit			
Beef Unit			
Posttest #1			
Posttest #2			

## DIARY

TEACHER \_\_\_\_\_

UNIT	DATE	NUMBER MINUTES	CIRCUMSTANCES
Beef Pretest			
Beef Unit			
Beef Unit			
Beef Unit			
Beef Unit			
Beef Unit			
Posttest #1			
Posttest #2			
Pretest			
Weeds Unit			
Weeds Unit			
Weeds Unit			
Weeds Unit			
Weeds Unit			
Posttest #1			
Posttest #2			

**APPENDIX F**

**FOLLOW-UP LETTER: RETURN POSTAGE**



Department of Agricultural  
Education

208 Agricultural  
Administration Building  
2120 Fyffe Road  
Columbus, OH 43210-1099  
Phone 614-292-6321

130

April 30, 1988

Sam Custer  
Versailles High School  
459 South Center Street  
Versailles, OH 45380

Dear Sam,

We would like to thank you again for taking part in this important research project being conducted by the Agricultural Education Department at The Ohio State University. We hope that you have found the lesson plans, handouts, and tests satisfactory in teaching the units.

It is professionals like you that have made the agricultural education profession, vocational agriculture, and the Future Farmers of America the outstanding educational opportunity that it is today. You are making a tremendous contribution to the profession by participating in this study. As a result of research the profession is better able to provide for the individual learning needs of its students. Research projects such as this could not be conducted without dedicated professionals such as you. You are to be commended on your professionalism and dedication to the youth of today.

Enclosed you will find a small token of appreciation for your effort and dedication to this research project. We hope the materials will be useful to you.

We have enclosed two envelopes to be used in returning materials from this study. After completion of the first unit, please return the unit tapes, pretests, attitude instrument, and posttest #1. A stamped self-addressed envelope has been included. A second stamped self-addressed envelope has been included for the materials associated with the second unit of instruction. Envelopes will be mailed at a later time for the second posttests.

Thank you very much for participating in the study. You have made a tremendous contribution to the knowledge about teaching and learning.

Sincerely yours,

L. H. Newcomb, Professor and Chair  
Agricultural Education Department

Harry N. Boone Jr., Graduate Student

**APPENDIX G**

**FOLLOW-UP LETTER: POSTTEST REMINDER**



Department of Agricultural  
Education

208 Agricultural  
Administration Building  
2120 Fyffe Road  
Columbus, OH 43210-1099  
Phone 614-292-6321

May 19, 1988

Sam Custer  
Versailles High School  
459 South Center Street  
Versailles, OH 45380

Dear Sam,

We would like to take this opportunity to thank you for participating in this important research study being conducted by the Agricultural Education Department at The Ohio State University. You have made a tremendous contribution to this research effort.

Your final contribution to the study is to administer the second posttest two weeks after the students completed the unit of instruction. We have enclosed a stamped envelope to use in returning the final two posttests. If you have not mailed the pretests, posttest #1, attitude instrument, and tapes, please do so as soon as possible. The data is being coded and entered into the computer as soon as it is received.

As the school year draws to a close, we wish you a happy and productive summer. Thank you for your time, effort, and dedication in assisting with this research study.

Sincerely yours,

L. H. Newcomb, Professor and Chair  
Agricultural Education Department

Harry N. Boone Jr., Graduate Student

**APPENDIX H**

**"CONTROLLING WEEDS IN CORN":  
PROBLEM SOLVING APPROACH UNIT PLAN**



I. Title: Controlling Weeds in Corn

II. Teacher Objectives:

The student will be able to:

- A. Identify the major reasons for controlling weeds in corn
- B. Identify major characteristics in identification of weeds
- C. List methods commonly used to control weeds in corn
- D. Evaluate a given situation and select a weed control program for that situation

III. Teaching Procedure:

A. Interest Approach

{Teachers: Use one of the interest approaches outlined to present the topic to the class and develop a felt need to know in the students. Pictures may be used or a field trip may be taken to a corn field on the school farm or other situation.}

Have students select a field in which corn will be planted on the school or home farm. They should evaluate the weed situation and describe what practices need to be used to control the weeds during this year's corn crop.

(Alternative) Show a slide or picture of a corn field that has a weed control problem. Identify this field as one the student will be responsible for preparing a management plan for this year. Also show slides or pictures of a field of corn that the weeds have been controlled. The students will compare the two fields and design a plan to manage the first field.

{Teachers: Have several students commit themselves to a management plan for the field used in the interest approach. Have the students place their suggestions on the board and record the suggestions to be used during the summary. Most likely students will say they are not sure what to do. This is really what you are hoping for. At this point note what we need to know more before we can develop a weed control program.

#### V. Anticipated Problems and Concerns

{Teachers: Draw these questions from the students with a good questioning strategy. Be sure these three questions are a part of the problems the students see as a part of this unit. Write the questions on the board as the students present them and request the students enter them in their notebook.}

(Lead Question) What are some questions we will need to answer before we can develop a program for controlling weeds in our field of corn?

- A. Why should we control the weeds in our corn?
- B. What methods can be used to control weeds in our corn?
- C. What weed control methods are best for our various situations?

Plans for solving each problem.

Problem 1: Why should we control the weeds in our corn?

{Teachers:

- ... Draw from students reasons to control weeds in corn
- ... Write the list on the board
- ... Have students place list in notebook

#### 1. Discussion:

(Lead Question) What effects do weeds have on a crop of corn?

- a. Reduce yields
- b. Lower quality of corn grain crop
- c. Increase production cost
- d. Increase labor and equipment costs
- e. Reduce land values
- f. Harbor insects and diseases
- g. Create water management problems
- h. Harm livestock
- i. Create human discomfort

{Teachers:

... Divide the students into groups

... Assign each group one or more of the following questions (Listed below) ...  
Have group brainstorm solutions to questions

during a short supervised study period  
... Bring class together and discuss findings

... Summarize the student solutions

... Use slides or pictures to illustrate points

... Include summary on board (Summary listed below)

... Have students place notes in notebook

(Questions for Group Discussion)

1. How do weeds reduce corn yields?

- a. Competition with corn (Overhead #2 located in unit plan)
- b. Rob soil nutrients (Overhead #3 located in unit plan)

- c. Use soil water
  - d. Compete for light and carbon dioxide
  - e. Create adverse effect of plants on each other
2. How do weeds reduce quality of crops?
- a. Presence of plants and/or seed in crop
  - b. Cause molding, spoilage, and odors
  - c. Cause dockage of price at market
3. How do weeds increase production cost and decrease land values?
- a. Increased seed bed preparation, planting, and harvesting costs
  - b. Increase harvesting time and machinery wear
  - c. Extra labor and equipment to separate weed from corn
  - d. Reduce land values
4. How do weeds harbor insects and diseases?
- a. Dwarf Mosaic virus winters on Johnsongrass
  - b. Weeds harbor corn borers
5. How do weeds create harmful situations for humans and livestock?
- a. Cocklebur seedlings and Jimsonweed are poisonous to livestock
  - b. Pollen from ragweed cause hayfever, and asthma problems in humans

**Summary**

1. Weeds reduce corn yields
2. Weeds reduce quality of crops
3. Weeds increase production cost and decrease land values
4. Weeds harbor insects and diseases
5. Weeds create harmful situations for humans and livestock

**Problem 2:** What methods can be used to control weeds in corn?

{Teachers:

- ... Use lead question to draw weed categories from students
- ... Give students a copy of handout #1 and #2
- ... Instruct students to use handout #2 and complete the chart on handout #1
- ... Give students a ten minute supervised study period to work on this
- ... At end of study period call students together and discuss the answers
- ... Use Overhead #4 to bring summary to question

(Lead Question) What information about the life cycle of weeds will be useful when designing a weed control program?

	Life Cycle	Ease of Control	When Best Destroyed
Annuals	One Year	Easy to control when small. Very persistent due to fast growth	Destroy before or during flowering
Biennials	Two Year	Best control occurs in first year	Destroy during Rosette stage
Perennial	More than Two Years	Eradication difficult	Varies from weed to weed

{Teachers:

- ... Lead a group discussion to determine methods farmers use to control weeds
- ... Place methods on the board and discuss key points about each
- ... Show students examples of each with slides or pictures

(Lead Question) What methods are commonly used in this community to control weeds in corn?

1. Primary Tillage

- a. Examples: Plowing, chisel plow
- b. Principle method of controlling weeds

2. Secondary Tillage

- a. Examples: disk, harrow, springtooth harrow, and rotary hoe
- b. Consists of shallow cultivation, such as that used to prepare a seedbed

### 3. No tillage

- a. Example: Special corn planter prepares seedbed only in row being planted.
- b. Dry loose layer on surface discourages weed germination.
- c. Area between rows is not worked and weeds are controlled with a herbicide.

### 4. Cutting, Hoeing, and Pulling

- a. Hand operations can be very effective in controlling weeds.
- b. Hoeing must be regular and often to weaken rootstocks.

### 5. Thick plant population

- a. Planting the thickest plant population possible will not cut the yield but crowd out weeds by shading.

### 6. Chemical control

- a. Chemical with modern cultivation methods has made weed control easier
- b. Herbicides will battle weed but are not the complete answer
- c. Farmers spend over 1 billion dollars per year herbicides

#### {Teachers:

- ... Divide the class into groups
- ... Give students handout #3 and #4
- ... Give students a supervised study period to determine advantages and disadvantages of each method of weed control
- ... Bring group together and assemble answers into a chart similar to one below

... Have students put chart in notebook

	Advantages	Disadvantage(s)
Primary tillage	<ol style="list-style-type: none"> <li>1 Kills annuals by turning them under</li> <li>2 Kills perennials by exposing underground parts</li> <li>3 Underground parts frozen after being exposed to fall plowing</li> </ol>	<ol style="list-style-type: none"> <li>1 Turn up other weed seed</li> <li>2</li> </ol>
Secondary tillage	<ol style="list-style-type: none"> <li>1 Destroys annuals that have started</li> <li>2 Depletes root reserves of perennials</li> </ol>	<ol style="list-style-type: none"> <li>1 Turns up other weed seeds</li> <li>2 Must be repeated at intervals</li> </ol>
No tillage	<ol style="list-style-type: none"> <li>1 Discourages weed seed germination by leaving dry loose surface on seedbed</li> <li>2 Area between rows not disturbed</li> </ol>	<ol style="list-style-type: none"> <li>1 Weeds must be controlled between rows with chemicals</li> </ol>
Cutting hoeing, and pulling	<ol style="list-style-type: none"> <li>1 Effective method in controlling annuals</li> <li>2 Weakens rootstock of perennials</li> </ol>	<ol style="list-style-type: none"> <li>1 Confined to small areas</li> <li>2 Expensive</li> <li>3 Labor intensive</li> </ol>
Thick plant population	<ol style="list-style-type: none"> <li>1 Maximum canopy to prevent weeds from growing</li> </ol>	<ol style="list-style-type: none"> <li>1 Crop must get a head start on weeds</li> </ol>
Chemical control	<ol style="list-style-type: none"> <li>1 Greatest potential for weed control</li> <li>2 Considerable savings over cultivation</li> <li>3 Controls weeds that normal cultivation cannot</li> <li>4 Requires half amount of labor</li> </ol>	<ol style="list-style-type: none"> <li>1 Residue problem</li> <li>2 Not complete answer</li> <li>3 Injure the crop</li> </ol>



**Problem 4: What weed control methods should I use?****{Teachers:**

- ... Develop a possibilities/factors chart to answer problem
- ... Explore factors in selecting a weed control program
- ... Use handout #3 and other textbook if you have them in your classroom for a supervised study period
- ... Evaluate each of the six methods discussed above with a "+" "-" or "0" for a positive factor, negative factor, or neutral factor respectively.
- ... Discuss why each factor is given that rating.}

	Labor	Expense	Weed	Injury
Primary tillage	0	0	+	+
Secondary Tillage	0	0	+	+
No tillage	+	+	0	0
Cutting, Hoeing, and pulling	-	-	+	+
Thick plant population	+	+	+	+
Chemical control	+	+	+	-

### Guidelines for selecting a weed control.

- A. Use high quality seeds
- B. Use recommended cultural practices
- C. Prevent weeds from forming seeds
- D. Use chemical weed killers

### Summary

Have students use the field they selected in the introduction to the unit. Have them evaluate the situation and develop a weed control program to use with the field. Students may be divided into teams if they are evaluating the school farm. Evaluate their plans and discuss them during the summary of the unit. Compare the final plans to the one developed in the introduction to the unit. (or to the fact that they were not able to develop a plan in the beginning of the unit).

### Approved Practices

1. Use high quality seeds
2. Use recommended cultural practices
3. Prevent weeds from forming seeds
4. Use chemical weed killers carefully as needed.
5. Identify and classify weeds before deciding upon a control method.
6. Use primary tillage to kill established annual weeds by turning them under and smothering them.
7. Fall plowing will expose roots of perennials to freezing conditions.
8. Use secondary tillage methods to destroy established annuals on plowed ground.
9. Use secondary tillage to deplete root reserves of perennials.

10. Use no tillage when you do not want to disturb area between rows.
11. Confine cutting, hoeing, and pulling to small areas because of expense and labor involved.
12. Plant the maximum plant population recommended to reduce weed population.
13. Use a balanced weed control program consisting of mechanical and chemical solutions.

#### References

- Ridenour, H. E. (1978). Weed control cultural and chemical. Columbus, OH:Ohio Agricultural Education Curriculum Materials Service.

APPENDIX I

"CONTROLLING WEEDS IN CORN":  
SUBJECT MATTER APPROACH UNIT PLAN

**SUBJECT MATTER**

I. Title: Controlling Weeds in Corn

II. Teacher Objectives:

The student will be able to:

- A. Identify the major reasons for controlling weeds in corn
- B. Identify major characteristics in identification of weeds
- C. List methods commonly used to control weeds in corn
- D. Evaluate a given situation and select a weed control program for that situation

III. Teaching Procedure:

A. Interest Approach

{Teachers: Use one of the interest approaches outlined to present the topic to the class. Pictures may be used or a field trip may be taken to a corn field on the school farm or other situation.}

Have students select a field in which corn will be planted on the school or home farm. They should evaluate the weed situation and describe what problems exist with weed control problems.

(Alternative) Show a slide or picture of a corn field that has a weed control problem. Show slides or pictures of a field of corn that the weeds have been controlled. The students will compare the two fields on weed control problems.

**Presentation****{Teachers:**

- ... Introduce topic of "Reasons for Controlling Weeds in Corn"
- ... Lead a large group discussion where students discuss why weeds must be controlled in a field of corn.
- ... Present the five major ideas by writing them on the chalkboard (Listed below)
- ... Discuss why each reason for controlling weeds is important
- ... Use overheads #1, #2, and #3 to assist with presentation (Enclosed in Unit Plan)
- ... Pictures or slides may be used to illustrate points
- ... Bring closure to problem by summarizing the reasons for controlling weeds in corn.}

**REASONS FOR CONTROLLING WEEDS IN CORN**

1. Weeds reduce corn yields
  - a. Competition with corn
  - b. Rob soil nutrients
  - c. Use soil water
  - d. Compete for light and carbon dioxide
  - e. Create adverse effect of plants on each other
2. Weeds reduce quality of crops
  - a. Presence of plants and/or seed in crop
  - b. Cause molding, spoilage, and odors
  - c. Cause dockage of price at market
3. Weeds increase production cost and decrease land values

- a. Increased seed bed preparation, planting, and harvesting costs
  - b. Increase harvesting time and machinery wear
  - c. Extra labor and equipment to separate weed from corn
  - d. Reduce land values
4. Weeds harbor insects and diseases
- a. Dwarf Mosaic virus winters on Johnsongrass
  - b. Weeds harbor corn borers
5. Weeds create harmful situations for humans and livestock
- a. Cocklebur seedlings and Jimsonweed are poisonous to livestock
  - b. Pollen from ragweed cause hayfever, and asthma problems in humans

{Teachers:

- ... Summarize the unit by reviewing the five major reasons for controlling weeds in corn
- ... Ask students to give examples of each reason
- ... Ask students to give a statement on why each reason is important

#### TYPES OF WEEDS

{Teachers:

- ... Introduce topic of "Types of Weeds"
- ... Identify the weed categories of annuals, biennials, and perennials.
- ... Draw the table below on the board or prepare a copy to be distributed to the students.  
(Handout - 1)
- ... Present key points to students on life cycle, ease of control, and when best destroyed with Overhead #4 (Handout - 1 and

Overhead #4 are included in unit plan)

... Have students use handout #1 to place information in notebook

... Summarize key points with overhead #4

	Life Cycle	Ease of Control	When Best Destroyed
Annuals	One Year	Easy to control when small. Very persistent due to fast growth	Destroy before or during flowering
Biennials	Two Year	Best control occurs in first year	Destroy during Rosette stage
Perennial	More than Two Years	Eradication difficult	Varies from weed to weed

#### METHODS OF WEED CONTROL

{Teachers:

- ... Introduce topic of "Methods of Weed Control"
- ... Identify the major methods of weed control used in the community (Listed Below)
- ... Place major methods on chalkboard
- ... Discuss examples and key points about each
- ... Use slides, pictures, or overheads to illustrate each method
- ... Have students place notes in notebook
- ... Summarize the examples and key points about each tillage method



1. Primary Tillage
  - a. Examples: Plowing, chisel plow
  - b. Principle method of controlling weeds
2. Secondary Tillage
  - a. Examples: disk, harrow, springtooth harrow, and rotary hoe
  - b. Consists of shallow cultivation, such as that used to prepare a seedbed
3. No tillage
  - a. Example: Special corn planter prepares seedbed only in row being planted.
  - b. Dry loose layer on surface discourages weed germination.
  - c. Area between rows is not worked and weeds are controlled with a herbicide.
4. Cutting, Hoeing, and Pulling
  - a. Hand operations can be very effective in controlling weeds.
  - b. Hoeing must be regular and often to weaken rootstocks.
5. Thick plant population
  - a. Planting the thickest plant population possible will not cut the yield but crowd out weeds by shading.
6. Chemical control
  - a. Chemical with modern cultivation methods has made weed control easier
  - b. Herbicides will battle weed but are not the complete answer
  - c. Farmers spend over 1 billion dollars per year herbicides

{Teachers:

- ... Summarize topic by reviewing major methods of weed control, examples of each and key points about each tillage method.

ADVANTAGES AND DISADVANTAGES OF METHODS OF WEED CONTROL

{Teachers:

- ... Introduce topic of "Advantages and Disadvantages" of each weed control method
- ... Review the major methods of weed control used in the community
- ... Present advantages and disadvantages of each method
- ... Use slides, pictures, or overheads to illustrate each method and key points
- ... Have students place notes in notebook
- ... Summarize the advantages and disadvantages of each tillage method
- ... Details on advantages and disadvantages are listed below in unit plan

	Advantages	Disadvantage(s)
Primary tillage	<ol style="list-style-type: none"> <li>1 Kills annuals by turning them under</li> <li>2 Kills perennials by exposing underground parts</li> <li>3 Underground parts frozen after being exposed to fall plowing</li> </ol>	<ol style="list-style-type: none"> <li>1 Turn up other weed seed</li> <li>2</li> </ol>
Secondary tillage	<ol style="list-style-type: none"> <li>1 Destroys annuals that have started</li> <li>2 Depletes root reserves of perennials</li> </ol>	<ol style="list-style-type: none"> <li>1 Turns up other weed seeds</li> <li>2 Must be repeated at intervals</li> </ol>
No tillage	<ol style="list-style-type: none"> <li>1 Discourages weed seed germination by leaving dry loose surface on seedbed</li> <li>2 Area between rows not disturbed</li> </ol>	<ol style="list-style-type: none"> <li>1 Weeds must be controlled between rows with chemicals</li> </ol>
Cutting hoeing, and pulling	<ol style="list-style-type: none"> <li>1 Effective method in controlling annuals</li> <li>2 Weakens rootstock of perennials</li> </ol>	<ol style="list-style-type: none"> <li>1 Confined to small areas</li> <li>2 Expensive</li> <li>3 Labor intensive</li> </ol>
Thick plant population	<ol style="list-style-type: none"> <li>1 Maximum canopy to prevent weeds from growing</li> </ol>	<ol style="list-style-type: none"> <li>1 Crop must get a head start on weeds</li> </ol>
Chemical control	<ol style="list-style-type: none"> <li>1 Greatest potential for weed control</li> <li>2 Considerable savings over cultivation</li> <li>3 Controls weeds that normal cultivation cannot</li> <li>4 Requires half amount of labor</li> </ol>	<ol style="list-style-type: none"> <li>1 Residue problem</li> <li>2 Not complete answer</li> <li>3 Injure the crop</li> </ol>

GUIDELINES FOR SELECTING A WEED CONTROL PROGRAM

- A. Use high quality seeds
- B. Use recommended cultural practices
- C. Prevent weeds from forming seeds
- D. Use chemical weed killers

{Teachers:

- ... Summarize key advantages and disadvantages of each method of weed control
- ... Place key points on chalkboard
- ... Have students place summary in notebooks

#### Summary

Summarize the key points of the unit with the use of the list of approved practices. The students will place this list of approved practices in their notebook. Use the slides or farm situation that was used in the interest approach to summarize the key points covered in this unit.

#### Approved Practices

1. Use high quality seeds
2. Use recommended cultural practices
3. Prevent weeds from forming seeds
4. Use chemical weed killers carefully as needed.
5. Identify and classify weeds before deciding upon a control method.
6. Use primary tillage to kill established annual weeds by turning them under and smothering them.
7. Fall plowing will expose roots of perennials to freezing conditions.

8. Use secondary tillage methods to destroy established annuals on plowed ground.
9. Use secondary tillage to deplete root reserves of perennials.
10. Use no tillage when you do not want to disturb area between rows.
11. Confine cutting, hoeing, and pulling to small areas because of expense and labor involved.
12. Plant the maximum plant population recommended to reduce weed population.
13. Use a balanced weed control program consisting of mechanical and chemical solutions.

#### References

- Ridenour, H. E. (1978). Weed control cultural and chemical. Columbus, OH:Ohio Agricultural Education Curriculum Materials Service.

**APPENDIX J**

**"CONTROLLING WEEDS IN CORN":  
HANDOUTS AND OVERHEAD MASTERS**

OVERHEAD - 1

# **EFFECTS OF WEEDS UPON A CORN CROP**



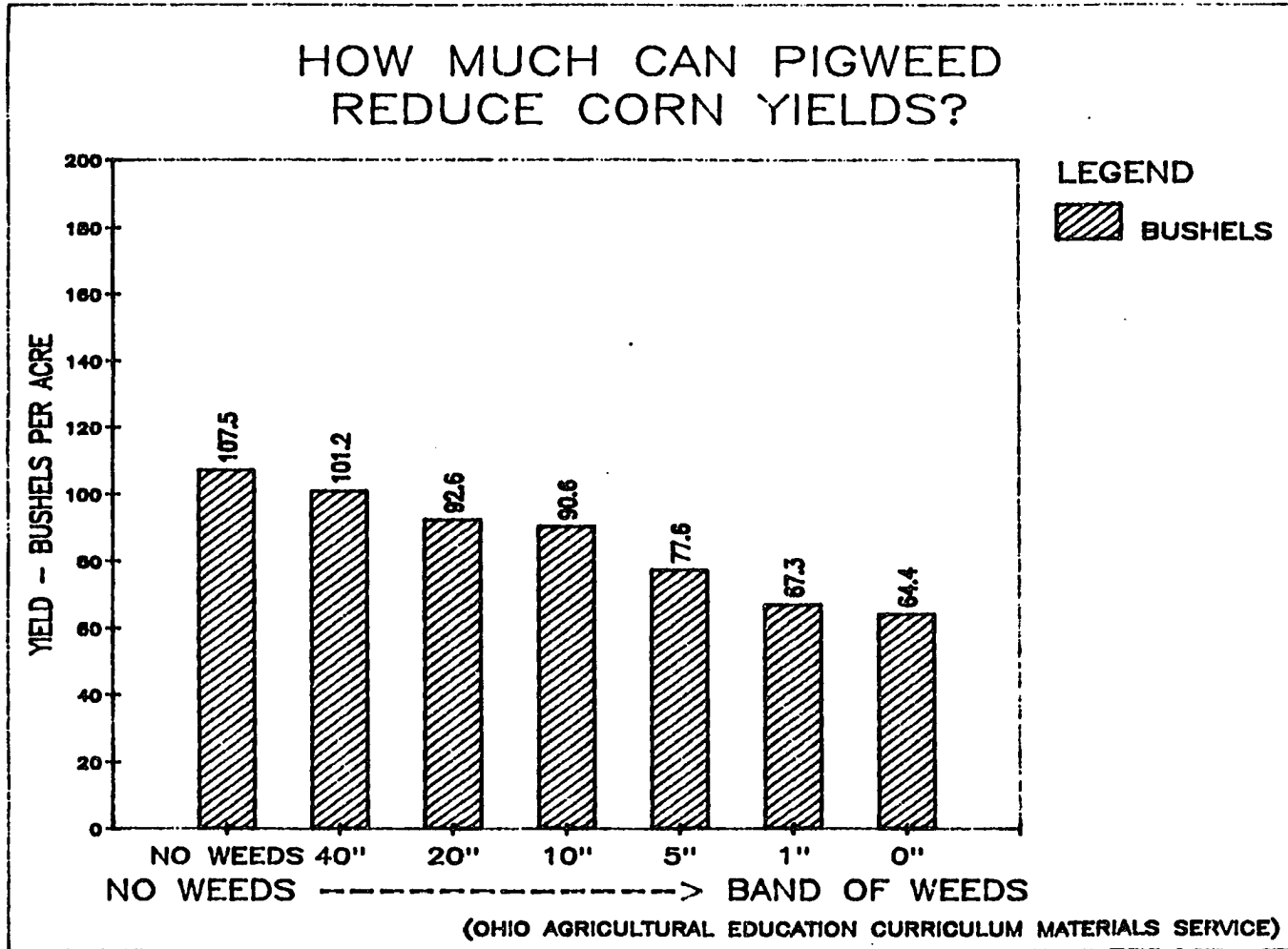
**REDUCE CORN YIELDS**

**REDUCE QUALITY OF CORN**

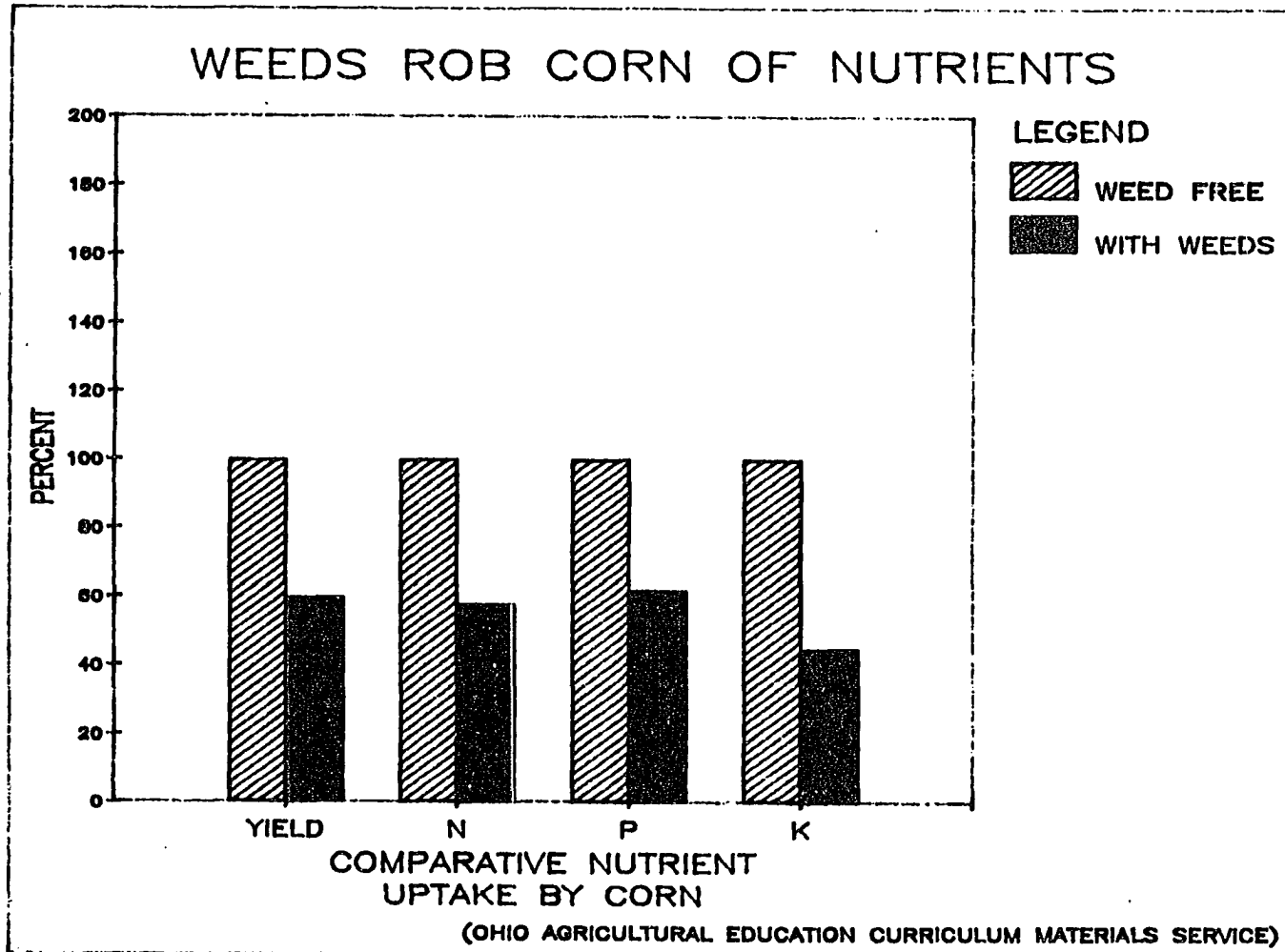
**INCREASE PRODUCTION COSTS AND  
DECREASE LAND VALUES**

**HARBORS INSECTS AND DISEASES**

**CREATE HARMFUL SITUATIONS FOR  
HUMANS AND LIVESTOCK**







OVERHEAD - 4

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## LIFE CYCLE OF WEEDS IN CORN

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<u>NAME</u>	<u>YEARS</u>	<u>EASE OF CONTROL</u>	<u>BEST DESTROYED</u>
ANNUALS	ONE YEAR	EASY TO CONTROL WHEN SMALL. VERY PERSISTENT DUE TO FAST GROWTH	BEFORE OR DURING FLOWERING
BIENNIALS	TWO YEARS	BEST CONTROL IN FIRST YEAR	DESTROY DURING ROSETTE STAGE
PERENNIALS	MORE THAN	ERADICATION DIFFICULT	VARIES FROM WEED TO WEED

## HANDOUT-1

	Life Cycle	Ease of Control	When Best Destroyed
Annuals			
Biennials			
Perennials			

## CLASSIFICATION OF WEEDS

What do you need to know about weeds to be able to control them? If you want successful control or eradication of weeds in your fields, you will need some information about their life or growth habits. This chapter will help you to define the weed problem before you look for the control method. Weeds differ from one another more than in appearance and can be classified into groups depending upon their life span. They differ also in life cycles, root systems, rate of growth, method of reproduction, and chemical resistance or tolerance. A classification system based on life span follows.

### Annuals

Annuals are plants that live only one year or less. During this period, they mature and produce seeds, thus completing their life cycle. Annuals are normally considered easy to control when small, but are very persistent due to their fast growth and abundant production of seed. All methods of controlling annuals have one principal purpose: the prevention of seeding. Annuals should be destroyed before or during early flowering. They usually cost less to control than perennials. Most common field weeds are of this group. Annuals are further classified into two types as follows:

□ *Summer Annuals.* Summer annuals germinate in the spring, produce seed, make most of their growth during the summer, and usually mature and die in the fall. Their seeds lie dormant in the soil until the following spring, then they begin another life cycle. Cocklebur, fox-tail, smartweed, ragweed, pigweed, lambsquarters, and crabgrass are examples which fall into this group. (See figure 7a.)

□ *Winter Annuals.* Winter annuals remain dormant in the summer, germinate in the fall and winter, and usually produce seed in the spring or early summer before dying. Cheat, henbit, little barley, wild mustard, and downy brome grass are examples. (See figure 7b.)

### Biennials

Biennials are plants that require two years to complete their life cycle. In the first year, they produce a well-developed root below the ground and a leafy rosette type of vegetative growth above the ground. They are dormant during the winter, but during the next year's growth a flower stalk elongates, produces seed, and dies.

Burdock, bull thistle, wild carrot, and wild parsnip are common biennials. Biennials should be destroyed during the rosette stage. They usually grow in pastures, roadsides, or other uncultivated areas. (See figure 7c.)

### Perennials

Perennials are plants that normally live for more than two years. They not only propagate by seed, but many of them produce underground structures such as rhizomes, budding roots, tubers, or bulbs. The above-ground portion of the plant may die back each year, but in the spring new growth develops from the underground parts. Because of their extensive root systems and ability to produce seeds, eradication or control is difficult. Perennials may be classified according to their method of reproduction: simple, bulbous, and creeping. (See figure 7d.)

□ *Simple Perennials.* This type of perennial spreads normally by seed. Injured or cut root pieces may produce new plants, but they have no normal means of spreading vegetatively. For example, a dandelion, curly dock, or plantain root cut in half may produce two plants. The roots are usually fleshy and may grow very large. (See figure 8.)

□ *Bulbous Perennials.* These reproduce by seed, aerial bulblets, and underground bulblets. Examples are wild garlic and wild onion. Wild garlic flowers usually produce only aerial bulblets. Seed is only occasionally formed. New bulbs form during the growing season on the old bulb base. (See figure 9.)

□ *Creeping Perennials.* These reproduce by seed, creeping roots, stolons (creeping above-ground stems), and rhizomes (creeping below-ground stems). There are many such perennials: Canada thistle, field bindweed, Johnsongrass, quackgrass, and oxeye daisy. (See figures 10 and 11.)

Some weeds such as nutsedge — nutgrass, maintain themselves and propagate by means of tubers which are the enlarged, fleshy, terminal portions of rhizome bearing buds. (See figure 12.)

The classification of weeds and examples given here apply mainly to Ohio. In other regions, the life span of a certain weed may vary because of climate and may vary even in the same climate. An annual weed where winters are severe may be biennial where winters are mild. Some plants which are biennials in one region may be perennial in another.

Source: Ridenour, H. E. (1978). Weed control cultural and chemical.  
Columbus, OH: Ohio Agricultural Education Curriculum  
Materials Service. p 8.

## CULTURAL OR MECHANICAL CONTROL

Cultural or mechanical weed control includes tillage, mowing, mulching, and hoeing; even hand pulling is justified under some conditions. The use of cultural practices is basic in any effective weed control program.

### TILLAGE

Tillage has long been one of the principal means of controlling weeds. Different times and methods of tillage will be discussed.\*

#### *Primary Tillage*

Primary tillage consists of plowing (figure 22), disking and field cultivating (figure 23), which perform major operations in working the soil. An additional benefit is that these operations are effective in killing weeds.

Deep tillage operations, such as plowing, bring lower layers of soil to the surface. This also turns up the underground parts of weeds. Exposing the underground parts of perennials can be very damaging to these plants.

□ Drying out will kill the underground parts of the plant which are turned up. Examples are Johnsongrass and quackgrass. (See figure 24.)

□ Freezing may kill the exposed underground parts of the plants which are turned up by fall plowing.

□ Plowing will turn weeds under and kill them by smothering.

The plow is also a very effective tool in killing annual weeds. However, turning up lower layers of soil also turns up other weed seeds. As we have seen, weed seeds remain viable in the soil for long periods of time.

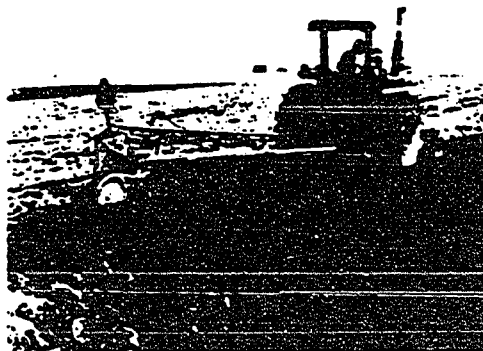


Figure 22. The plow may be used for the primary tillage operation. (USDA Photo Service)

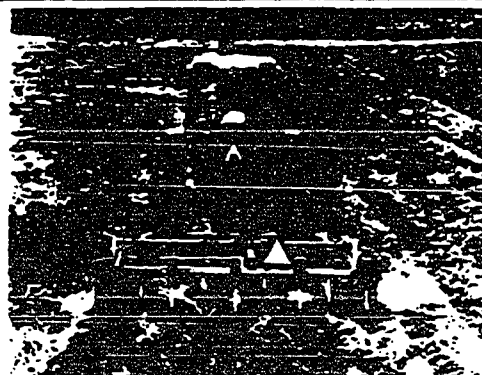


Figure 23. The heavy spring tooth or chisel plow may be used for primary tillage. (USDA Photo Service)

\*For more complete information about selecting a tillage system for your farm, see the manual *Tillage Systems*, available from the same source as this manual.

### Secondary Tillage

Secondary tillage consists of shallow cultivation, such as that used to prepare a seedbed after primary tillage. Such implements as the disk, the harrow, springtooth harrow, and rotary hoe may be used. Secondary cultivation may also be used as a weed control measure. (See figure 25.)

▫ *Seedbed preparation* destroys many weeds. It has been estimated that 90 percent of the annual weeds germinate during the period of April 15 to May 30. If the seedbed is prepared the last of April, a large proportion of the annual weeds will not have germinated. On the other hand, if the final seedbed is prepared on May 15 or later, the bulk of the annual weed seeds will have germinated and will be killed in the process. Figure 26 shows weeds which have recently germinated.

▫ *Spring tillage may be used to control perennials.* Breaking up the surviving rhizomes in the spring causes more buds to germinate. The time to start spring tillage is before flowering when root reserves are lowest. Repeated tillage 8 to 14 days after shoots emerge is then necessary to deplete root reserves. (See figure 24.) Secondary tillage operations, unless they are very shallow, will turn up other groups of weed seeds. Thus, the control of one group of weeds may be the cause for the start of another. Unless other control measures are employed, the secondary tillage operation will need to be repeated at intervals.

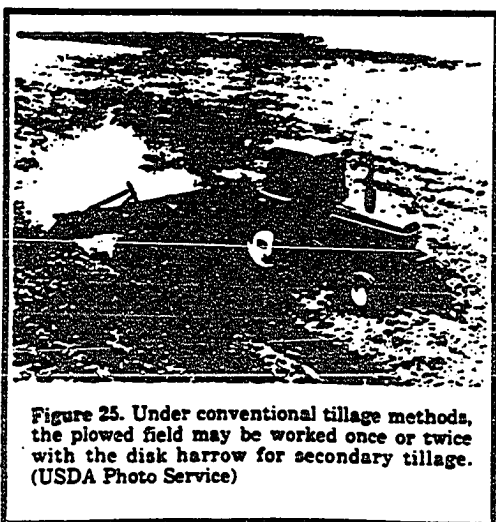


Figure 25. Under conventional tillage methods, the plowed field may be worked once or twice with the disk harrow for secondary tillage. (USDA Photo Service)

### CHEMICAL CONTROL

Weed control by chemical (herbicides) offers the greatest potential. Herbicides often control weeds at a considerable savings over cultivation costs. In some cases, herbicides control weeds that cannot be controlled by normal tillage practices.

American farmers spend about one billion dollars on herbicides for nearly two hundred million acres each year. The use of herbicides combined with modern cultivation methods has made weed control methods easier for the farmer. At one time, this task required about half of his working time during the cropping season.

A word of caution is in order. Herbicides can help battle weeds, but they are not the complete answer. Herbicides often do not control weeds as well as the farmer might expect. Occasionally they may injure the crop and sometimes they even injure the following crop. The chances for success can be improved and risks reduced by

selecting an approved herbicide, following the recommended rate of application, and applying the herbicide properly while taking appropriate precautions.

Any one method of weed control is not enough; it takes the well-planned integration of all of these methods into a long-range, overall program to obtain the maximum return for your money and effort.

It has been observed that well-planned cultivation and chemical weed control programs will:

- Significantly increase crop yield,
- Improve the quality of crops,
- Improve harvesting efficiency,
- Reduce weed seeds in the soil,
- Reduce labor requirements, and
- Improve the quality of the environment.

Handout - 3

**Thick Plant Population**

Plant the thickest plant population (including row spacing) possible which will not cut the crop yield but will crowd out weeds by shading them. Certain weeds vary in their response to shading by other plants as follows:

- *Intolerant of shade* — rough pigweed (*Amaranthus retroflexus*) and green foxtail (*Setaria viridis*).
- *Supressed by corn* — lambsquarters (*Chenopodium album*), common sunflower (*Helianthus annuus*), Pennsylvania smartweed (*Polygonum pennsylvanicum*), common ragweed (*Ambrosia artemisiifolia*), wild buckwheat (*Polygonum convolvulus*), common peppergrass (*Lepidium virginicum*), and yellow wood sorrel (*Oxalis europaea*).
- *Supressed by winter wheat* — cocklebur (*Xanthium pennsylvanicum*), Indian hemp or dogbane (*Apocynum cannabinum*), prairie rose (*Rosa arkansana*), common milkweed (*Asclepias syriaca*), spotted spurge (*Euphorbia maculata*), and field bindweed or wild morning glory (*Convolvulus arvensis*).

**No Tillage**

No tillage involves the use of a special planter with attachments which prepare a seedbed only in the rows being planted. (See figure 36.) The strips which are worked leave a dry loose layer of soil on the surface which discourages the germination of weed seeds. The corn is seeded deeper in moist soil and will germinate under normal growing conditions. The area between the rows is not worked and weeds must be controlled here with herbicides.

**Cutting, Hoeing, and Pulling**

In general, we are living in an era of mechanization, but hand operations are still very important in weed control. Because of the "back breaking" character of the method, such practices are confined to small areas of the widely scattered weeds in larger areas. Thousands of dollars are spent each year in vegetable areas for hand removal of weeds. It has been clearly demonstrated in practice that such weeds as wild morning glory can be eradicated by hoeing. The hoeing must be often and regular in order to weaken the rootstocks to the extent that no more shoots will be sent up. In hoeing, be certain that the plants are cut below the crowns.

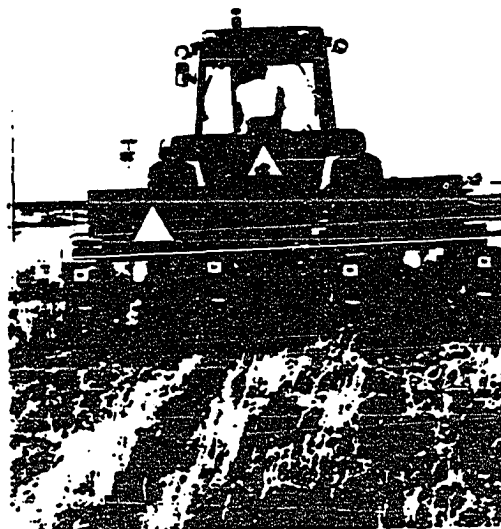


Figure 36. No tillage leaves a band with a dry, loose topsoil layer which discourages weed seedling growth. (John Deere)

## HANDOUT - 4

	Advantage(s)	Disadvantage(s)
Primary tillage		
Secondary Tillage		
No tillage		
Cutting, Hoeing, and pulling		
Thick plant population		
Chemical control		



APPENDIX K  
"CONTROLLING WEEDS IN CORN":  
TEST QUESTIONS

## CONTROLLING WEEDS IN CORN TEST QUESTIONS

Instructions: Read each question carefully. Select the most correct answer. Place the letter of the correct answer in the space provided to the left of the number of the question.

- \_\_\_ 1. What type of weeds are the most difficult to eradicate?
- A. Annual
  - B. Biennial
  - C. Perennial
  - D. Seasonal
- \_\_\_ 2. The best time to eradicate weeds is:
- A. When they are young (0-4 weeks old)
  - B. When they are flowering
  - C. When they are producing seeds
  - D. After they are fully mature
- \_\_\_ 3. Which control method requires the most labor?
- A. Primary tillage
  - B. Secondary tillage
  - C. No tillage
  - D. Cutting, Hoeing, Pulling
  - E. Thick plant populations
  - F. Chemical Weed Control
- \_\_\_ 4. No Tillage controls weeds by
- A. Leaving a dry, loose seedbed surface
  - B. Weakening the rootstock of perennials
  - C. Chemical Application
  - D. Both A and B
  - E. Both A and C

- \_\_\_\_\_ 5. Controlling weed may help to control insects and diseases.
- A. True
  - B. False
- \_\_\_\_\_ 6. Which of the following would be the most inexpensive means for controlling weeds in a relatively clean field?
- A. Primary tillage
  - B. Secondary tillage
  - C. No tillage
  - D. Cutting, Hoeing, Pulling
  - E. Thick plant populations
  - F. Chemical Weed Control
- \_\_\_\_\_ 7. Which is not a major reason for controlling weeds in corn production?
- A. Weeds reduce land values
  - B. Weeds create water management problems
  - C. Weeds fix nitrogen in the soil
  - D. Weeds lower the quality of the corn grain crop
- \_\_\_\_\_ 8. Which of the following economic inputs is not associated with weed control in corn production?
- A. Seed corn costs
  - B. Seedbed preparation
  - C. Planting costs
  - D. Harvesting costs
- \_\_\_\_\_ 9. A plant that lives for more than one year but fewer than three years is referred to as a -----.
- A. Annual
  - B. Biennial
  - C. Perennial
  - D. Seasonal
- \_\_\_\_\_ 10. Infestation of a corn crop will cause the corn production to -----.
- A. Increase
  - B. Decrease
  - C. Stay the same

- \_\_\_ 11. A plant that lives for one year referred to as a -----.
- A. Annual
  - B. Biennial
  - C. Perennial
  - D. Seasonal
- \_\_\_ 12. Biennials produce seed during the \_\_\_ year of life
- A. First
  - B. Second
  - C. Third
  - D. Fourth
- \_\_\_ 13. Biennials are best destroyed during the -----stage.
- A. Seedling
  - B. Rosette
  - C. Flower stalk
  - D. Reproduction
- \_\_\_ 14. Which of the following are examples of primary tillage?
- A. Plowing
  - B. Chisel Plowing
  - C. Disking
  - D. Springtooth harrow
  - E. Both A and B
  - F. Both C and D
- \_\_\_ 15. Which of the following are examples of secondary tillage?
- A. Plowing
  - B. Chisel Plowing
  - C. Disking
  - D. Springtooth harrow
  - E. Both A and B
  - F. Both C and D
- \_\_\_ 16. Using thick plant populations will help with weed control by -----.
- A. Preventing germination of weed seeds
  - B. Crowd out weeds by shading them
  - C. Uses available nutrients and starves weeds
  - D. None of the above

- \_\_\_\_\_ 17. A good weed control program will include -----.
- A. Mechanical weed control methods
  - B. Cultural weed control methods
  - C. Chemical weed control methods
  - D. A combination of A, B, and C
- \_\_\_\_\_ 18. One of the disadvantages of primary and secondary tillage methods is -----.
- A. Turns up other weed seeds
  - B. Exposes underground parts of perennials
  - C. Destroys annuals that have started
  - D. Does not effect biennials
- \_\_\_\_\_ 19. Which of the following problems for humans are caused by weeds?
- A. Poison ivy
  - B. Ragweed pollen
  - C. None of the above
  - D. Both A and B
- \_\_\_\_\_ 20. A plant that lives for more than two years is referred to as a(n)-----.
- A. Annual
  - B. Biennial
  - C. Perennial
  - D. Seasonal
- \_\_\_\_\_ 21. A field of corn has a heavy infestation of ragweed. Which of the following would be most likely to happen to the corn grain?
- A. Molding of corn grain
  - B. Spoilage of grain
  - C. Dockage of price at market
  - D. All of the above

- \_\_\_\_\_ 22. Farmer A and Farmer B bought new combines at the same time. Both harvest the same number of acres of corn per year. Farmer B has a better weed control program than Farmer A. Which machine would wear out first based upon information given in this problem.
- A. Farmer A's
  - B. Farmer B's
  - C. can't tell from information given
  - D. There will not be a difference in wear
- \_\_\_\_\_ 23. A field has an infestation of ragweed (Annual). You normally use conventional tillage methods when planting corn. What method of weed control would be the most economical in this situation?
- A. Primary tillage
  - B. Secondary tillage
  - C. No tillage
  - D. Cutting, Hoeing, Pulling
  - E. Thick plant populations
  - F. Chemical Weed Control
- \_\_\_\_\_ 24. No tillage methods of planting corn can effectively be used without chemical weed control.
- A. True
  - B. False
- \_\_\_\_\_ 25. Which of the following is an advantage of having weeds in a corn crop?
- A. Reduce yields of corn
  - B. Reduce quality of corn
  - C. Increase production costs
  - D. None of the above
- \_\_\_\_\_ 26. How does the use of high quality (Pure) seeds help in weed control?
- A. Prevents the spreading of weed seeds in grain seed
  - B. Reduces seedbed preparation costs
  - C. Increases harvesting costs
  - D. Increases chemical control costs

- \_\_\_\_\_ 27. Weed Control by chemical methods offer the following advantages to the farmer:
- A. Controls weeds at a savings over cultivation costs
  - B. Controls weeds that cannot be controlled by normal tillage methods
  - C. Reduces the risk of injury to the crop
  - D. All of the above
  - E. A and B above
- \_\_\_\_\_ 28. Farmer A has a field with an infestation of perennial weeds. What practice(s) could be used to control the perennials with the least amount of expense?
- A. Primary tillage
  - B. Secondary tillage
  - C. No tillage
  - D. Cutting, Hoeing, Pulling
  - E. Thick plant populations
  - F. Chemical Weed Control
  - G. Combination of A, B, E, and F
- \_\_\_\_\_ 29. Farmer A has an infestation of perennial weed in a corn field. What would be the most logical solution to take during the fall to reduce the weed problem the following spring?
- A. Primary tillage
  - B. Secondary tillage
  - C. No tillage
  - D. Cutting, Hoeing, Pulling
  - E. Thick plant populations
  - F. Chemical Weed Control
- \_\_\_\_\_ 30. The best way to control an annual weed problem in the future is:
- A. Hoeing, pulling, or cutting
  - B. Prevent weeds from producing seeds
  - C. Primary tillage
  - D. All of the above

Identify the following as primary or secondary tillage methods. (Place an "A" beside the method if it is a primary tillage method.) (Place an "B" beside the method if it is a secondary tillage method.)

- \_\_\_ 31. Plowing
- \_\_\_ 32. Chisel Plowing
- \_\_\_ 33. Disking
- \_\_\_ 34. Springtooth harrow
- \_\_\_ 35. Rotary hoe
- \_\_\_ 36. Perennials are classified by their method of reproduction.
- A. True
  - B. False
- \_\_\_ 37. Which classification of weeds costs the least amount to control?
- A. Annuals
  - B. Biennials
  - C. Perennials
  - D. Seasonal
- \_\_\_ 38. Which weed problem will usually cost the least amount to control?
- A. Canadian Thistle
  - B. Wild Carrot
  - C. Ragweed
  - D. Yellow nutsedge
- \_\_\_ 39. No tillage involves the use of a special planter with attachments which prepare a seedbed only in the rows being planted.
- A. True
  - B. False



\_\_\_\_ 40. Secondary and primary tillage can increase weed problems by turning up other groups of weed seeds.

- A. True
- B. False

APPENDIX L  
"CONTROLLING WEEDS IN CORN":  
ATTITUDE INSTRUMENT

INSTRUCTIONS FOR ATTITUDES  
TOWARD TEACHING METHODS INSTRUMENT

INSTRUCTIONS TO TEACHERS: Please administer this instrument as soon as possible after the completion of the achievement test on the unit of instruction. Make sure that all students have adequate time to complete all of the items on the questionnaire.

Have a student collect the papers and place them in the envelope to be mailed to me. I will provide you a summary of their responses.

READ THESE INSTRUCTIONS TO THE STUDENTS:

1. This questionnaire is to determine how you felt about the way the last unit was taught. You will consider only how the last unit was taught and not how the entire course has been taught.
2. This is not a test. Please answer each item according to your opinion of the way the unit was taught.
3. **SOME OF THE STATEMENTS ARE NEGATIVE STATEMENTS!** Keep in mind that marking **STRONGLY AGREE** will not always mean that you liked the teaching method. It is important that you read each statement carefully.
4. Answer each question honestly. The purpose of this questionnaire is to determine your opinions. There is no right or wrong answer.
5. Complete confidentiality will be observed.

### ATTITUDE TOWARD TEACHING METHODS

This instrument has been prepared so that you can share your opinions about the methods used to teach the last unit. Teaching method refers to the way the class was conducted. PLEASE RESPOND TO EVERY ITEM. In each case draw a circle around the letter which represents your own reaction to the item. The letters in the questionnaire represent the following statements:

SD if you STRONGLY DISAGREE with the statement  
 D if you DISAGREE, but not strongly so  
 N if you are NEUTRAL or UNDECIDED  
 A if you AGREE, but not strongly so  
 SA if you STRONGLY AGREE with the statement

Remember, the only correct answer is the one which actually represents how you felt about the unit that was just completed.

- |  | Circle Your Response |
|--|----------------------|
| 1. I enjoyed the methods used in teaching the unit.  | SD D N A SA          |
| 2. I liked this method for teaching this unit better than other methods my teachers have used. | SD D N A SA          |
| 3. I feel that I did not learn much about the topic.   | SD D N A SA          |
| 4. The methods used to teach this unit did not make the topic very interesting.                | SD D N A SA          |
| 5. The "Controlling Weeds in Corn" unit gave me real enthusiasm for the topic.                 | SD D N A SA          |
| 6. The method of instruction was very challenging to me.                                       | SD D N A SA          |
| 7. I wish that other classes were taught using the teaching method used for this unit.         | SD D N A SA          |

PLEASE RESPOND TO EVERY ITEM. In each case draw a circle around the letter which represents your own reaction to the item. The letters in the questionnaire represent the following statements:

SD if you STRONGLY DISAGREE with the statement  
 D if you DISAGREE, but not strongly so  
 N if you are NEUTRAL or UNDECIDED  
 A if you AGREE, but not strongly so  
 SA if you STRONGLY AGREE with the statement

- |  | Circle Your Response |
|--|----------------------|
| 8. There was not as much student participation as there should have been.  | SD D N A SA          |
| 9. I learned more because of the teaching methods used for this unit.  | SD D N A SA          |
| 10. The method of instruction for this unit did not give me enough freedom to express ideas.   | SD D N A SA          |
| 11. The class sessions were enjoyable.   | SD D N A SA          |
| 12. The method of instruction encouraged me to develop my own conclusions concerning the topic.                                      | SD D N A SA          |
| 13. I am not motivated to work as hard when this method is used.   | SD D N A SA          |
| 14. As a result of the teaching method, I feel confident that I can use what I learned about the topic when I have the opportunity.  | SD D N A SA          |
| 15. Compared to other teaching methods, I felt like I had less responsibility for what I learned when this teaching method was used. | SD D N A SA          |

**APPENDIX M**

**"PREPARING BEEF CATTLE FOR SHOW:"  
PROBLEM SOLVING APPROACH UNIT PLAN**

I. Title: Preparing Beef Cattle for Show

II. Teacher Objectives:

The student will be able to:

- A. Describe the procedures necessary to prepare a beef animal to lead and pose for a show.
- B. List the equipment needed to fit and show cattle.
- C. List the preparations necessary to prepare a beef animal for show.
- D. Demonstrate the basic skills necessary to show beef cattle.

III. Teaching procedure:

A. Interest Approach

Arrange for a dirty animal that has just been removed from the herd to be brought to the school. Arrange for an inexperienced senior student to demonstrate how to prepare and show the animal. Then demonstrate how this animal should be prepared and shown. This will help develop a felt need to know. If possible assign each student an animal from the school farm to break and show. Arrange a contest and prizes for the winner.

Alternate Approach: Show student pictures or slides of beef cattle prepared for show and beef cattle as they would come out of a field. Discuss how the two animals differ in general appeal. Ask the students to tell the class exactly how they would get the field animal to look exactly like the show animal. Pursue the idea on how the animals are different and what steps were taken to make the show animal different. If the students are unable to answer this then make the transition by discussing what

would the student need to know in order to fit and show the field animal.

V. Anticipated problems and concerns:

{Teachers: Draw these questions from the students with a good questioning strategy. Be sure these four questions are a part of the problems the students see as a part of this unit. Write the questions on the board as the students present them and request the students enter them in their notebooks.

(Lead Question) What are some questions we will need to answer before we can prepare and show beef cattle?

1. How is the beef animal trained to lead and pose for a show?
2. What equipment and supplies are needed to fit and show beef cattle?
3. What preparations are taken to prepare a beef animal for the show?
4. What guidelines are recommended for conduct in the show ring?

Problem #1: How is the beef animal gentled and trained to lead and pose for a show?

{Teacher:

- ... Use slides, pictures, or videotape to compare an animal that has not been broken and one broken for showing
- ... Discuss what steps will need to be taken to to take the animal that has not been broken and make it handle like the show animal (listed below)
- ... Draw as many answers from the class and place them on the board
- ... Give students reference material that may be available in the classroom discover what is missing from the list Handout - 1 (IN PACKET) may be used as a



reference

... Bring the class together and summarize the finding

... Have students place findings in their notebook

(Lead question) What steps should be taken to gentle and train a beef animal?

{Teachers: Use slides, or pictures to illustrate each of the following points}

1. Gentle by petting and brushing the animal during feeding and other appropriate times
2. Put a halter on the animal and secure animal to solid object
3. Teach the animal to lead with the halter
4. Lead animal from the left with the rope in the right hand.
5. Train to pose or stand correctly on all four feet
6. When you stop the animal try to get forefeet slightly higher than rear feet
7. Animals back should be held perfectly straight
8. Head should be level with the top of the back
9. When posing the animal, hold the strap in the left hand and face toward the animal.
10. A show stick is used in placing the hind feet of the animal but the showman's foot is best used in obtaining correct placement on the hind feet.

{Teachers:

... Use slides, videotape or pictures to demonstrate the concept in each of the practices above. This will bring closure to the problem and summarize the points that need to be made.}

Problem #2: What equipment and supplies are needed to fit and show beef cattle?

{Teachers:

- ... Arrange for pictures, overheads or a display of equipment that is commonly used when showing beef cattle.
- ... Arrange to have a few pieces of equipment that is not used in the group.
- ... Divide the class into small groups and assign them a number of items to discover the uses of each piece of equipment as it relates to showing beef cattle.
- ... Bring the group back together and make a list of materials and equipment needed to show beef cattle.
- ... Be sure the list contains all of the items listed below
- ... If the students do not mention them, draw them out with well designed questions
- ... List the more common uses of each of the items.
- ... Summarize the basic equipment needed to prepare and show beef cattle and instruct the students to place the information in their notes.}

A. (Lead Question) What equipment may be needed to show beef cattle?

{Teachers: Use slides, or pictures to illustrate each of the following points}

Brushes  
 Curry comb  
 Scotch comb  
 Material and cloth for polishing hoofs  
 Shampoo  
 Blueing  
 Butch wax or saddle soap  
 Rasp  
 Knife  
 Rope and leather halters

Show stick  
Hair oil  
Clippers  
Thinning shears  
Water bucket  
Feed boxes  
Grooming chute  
Fans  
Hair dryer

{Teachers:

- ... Summarize by asking students to identify each piece of equipment and give its use.

Problem #3: What preparations are taken to prepare a beef animal for the show?

{Teachers:

- ... Through a list of questions and steps and key points have the students list the preparations that should be taken to prepare a beef animal for show.
- ... Use lead questions (Listed below in unit plan) as study questions for a supervised study period of twenty minutes (Handout - 2)
- ... Use beef production reference books or Handout-3 for supervised study period on preparing animals for show
- ... At the end of about twenty minutes have the students present their findings.
- ... Be sure to include the list presented below. If it does not, draw items from students with well designed questions
- ... Summarize the problem by placing key findings on the board
- ... Have students place key findings in notebook

(Lead Question) What care will be taken of the animals feet?

{Teachers: Use slides, or pictures to illustrate each of the following points}

1. Feet are trimmed so animal will stand squarely and walk properly.
2. Trim the hoofs lightly at any one time
3. Do not work on the feet immediately before a show
4. Clean, oil, or spray paint hoofs and dew claws before entering the show ring

(Lead Question) What steps are needed to groom an animal for show?

{Teachers: Use slides, or pictures to illustrate each of the following points}

1. Clip animals according to decrees of breed and type of animal (breeding or steer)
2. Clip 1 week before the show to avoid just clipped look
3. Trim underline 3 to 4 weeks before the show to make animal appear trimmer
4. Clip tail from high point of twist to the tailhead
5. Wash animal monthly until 6 weeks before show
6. Wash animal weekly the last 6 weeks before the show
7. Rinse off animal to remove all traces of soap
8. Curl the body hair by pulling up hair all over the body, then clipped down to the desired length, so as to shape the animal properly
9. "Bone" the animal with a limited amount of saddle soap or butch wax between the knee and ankle of the front legs and between the hock and the ankle of the hind leg, then comb the hair so that it stands straight out from the leg

10. Clean and fluff the switch
11. Oil the animal after "boning" and "teasing" with a hair dressing

{Teachers:

- ... Summarize question by placing key points on chalkboard
- ... If possible have a demonstration of key points to refresh student's memory
- ... Be sure key points are included in students notebook

Problem #4: What guidelines are recommended for conduct in the show ring?

{Teachers:

- ... Develop a comical role play where two types of showman are presented. One has never shown an animal before and makes all types of mistakes. The other is a polished, professional showman.
- ... Lead the students through a discussion of what showman #1 needs to do in order to acquire the skills that showman #2 has. (Possible supervised study with Handout - 4)
- ... Use lead questions to center the discussion around
- ... Summarize the points and be sure to discuss the importance of each item.}

(Lead Question) What are some of the basic guiding principles that are used by successful cattle showmen?

{Teachers: Use slides, or pictures to illustrate each of the following points}

1. Train the animal long before entering the show ring
2. Have the animal carefully groomed and parade before the judge

3. Dress neatly for the occasion
4. Enter the ring promptly when the class is called
5. Lead animal from the left side with the halter strap in right hand
6. When asked to line up, go quickly but not brashly
7. When stopped pose animal correctly
8. Stroke the animal along the back or under the belly while posing
9. When the judge handles your animal, react properly
10. Keep one eye on the judge and one on the animal
11. Never stand so that you block the judge's view
12. Keep calm and collected
13. Be courteous and respect the rights of other exhibitors
14. Do not speak to the judge unless he asks you questions
15. Be a good sport

### Summary

Students will demonstrate how to train, prepare, and show a beef animal from the school farm. (Alternate) Students will outline the procedure and a time schedule for preparing a beef animal for a show. Each student will develop a plan of action to be used in breaking, training, and fitting a beef animal. The plan of action will take an animal from the field that has never been broken and describe in detail the steps and procedures that would be followed to turn this animal into an animal that could be used on the show circuit. They will include key points that were made during this unit. This plan of action will be turned in and graded by the instructor.

**Approved Practices**

1. Lead animal from the left with the rope in the right
2. Train to pose on all four feet
3. When posing the animal, hold the strap in the left hand and face toward the animal.
4. A show stick is used in placing the hind feet of the animal but the showman's foot is best used in obtaining correct placement on the hind feet.
5. Feet are trimmed so animal will stand squarely and walk properly.
6. Clean, oil, or spray paint hoofs and dew claws before entering the show ring
7. Clip animals according to decrees of breed and type of animal (breeding or steer)
8. Clip 1 week before the show to avoid just clipped look
9. Trim underline 3 to 4 weeks before the show to make animal appear trimmer
10. Clip tail from high point of twist to the tailhead
11. Curl the body hair by pulling up hair all over the body, then clipped down to the desired length, so as to shape the animal properly
12. "Bone" the animal with a limited amount of saddle soap or butch wax between the knee and ankle of the front legs and between the hock and the ankle of the hind leg, then comb the hair so that it stands straight out from the leg
13. Clean and fluff the switch
14. Oil the animal after "boning" and "teasing" with a hair dressing
15. Have the animal carefully groomed and parade before the judge

16. Dress neatly for the occasion
17. Enter the ring promptly when the class is called
18. Stroke the animal along the back or under the belly while posing
19. When the judge handles your animal, react properly
20. Keep one eye on the judge and one on the animal
21. Never stand so that you block the judge's view

**References:**

Ensminger, M. E. (1976). Beef cattle science.  
Danville, Illinois: The Interstate Publishers,  
Inc.



APPENDIX N

"PREPARING BEEF CATTLE FOR SHOW:"  
SUBJECT MATTER APPROACH UNIT PLAN

**SUBJECT MATTER****I. Title: Preparing Beef Cattle for Show****II. Teacher Objectives:**

The student will be able to:

- A. Describe the procedures necessary to prepare a beef animal to lead and pose for a show
- B. List the equipment needed to fit and show cattle.
- C. List the preparations necessary to prepare a beef animal for show
- D. Demonstrate the basic skills necessary to show beef cattle.

**III. Teaching procedure:****A. Interest Approach**

Arrange for a dirty animal that has just been removed from the herd to be brought to the school. Arrange for an inexperienced senior student to demonstrate how to prepare and show the animal. Then demonstrate how this animal should be prepared and shown.

**Alternate Approach:** Show student pictures or slides of beef cattle prepared for show and beef cattle as they would come out of a field. Discuss how the two animals differ in general appeal.

GENTLING AND TRAINING BEEF ANIMALS

{Teacher:

- ... Introduce topic of "Gentling and Training Beef Cattle"
- ... Use slides, pictures, or videotape to compare an animal that has not been broken and one broken for showing (If you don't have visual aids then discuss differences)
- ... Present steps that will need to be taken to to take the animal that has not been broken and make it handle like the show animal
- ... Use Handout - 1
- ... Place key points on the chalkboard
- ... Discuss reasons for each key point or step
- ... Summarize findings and place ideas on chalkboard
- ... Have students place findings in their notebook

A. Steps in gentling and training an animal

1. Gentle by petting and brushing the animal during feeding and other appropriate times
2. Put a halter on the animal and secure animal to solid object
3. Teach the animal to lead with the halter
4. Lead animal from the left with the rope in the right hand.
5. Train to pose or stand correctly on all four feet (Each foot should be directly under the respective quarter)
6. When you stop the animal try to get forefeet slightly higher than rear feet

7. Animals back should be held perfectly straight
8. Head should be level with the top of the back
9. When posing the animal, hold the strap in the left hand and face toward the animal.
10. A show stick is used in placing the hind feet of the animal but the showman's foot is best used in obtaining correct placement on the hind feet.

{Teachers:

- ... Summarize and review key points of topic
- ... Be sure students write summary in notes

#### EQUIPMENT AND SUPPLIES NEEDED TO SHOW CATTLE

{Teachers:

- ... Introduce topic of "Equipment and Supplies"
- ... Arrange for pictures, overheads or a display of equipment that is commonly used when showing beef cattle.
- ... Identify the commonly used equipment for showing cattle
- ... Discuss with students the common uses of each piece of equipment
- ... Be sure the list contains all of the items listed below
- ... Summarize and instruct the students to place the information in their notes.}

#### A. Equipment that may be needed to show beef cattle

Brushes  
 Curry comb  
 Scotch comb  
 Material and cloth for polishing hoofs  
 Shampoo

Blueing  
Butch wax or saddle soap  
Rasp  
Knife  
Rope and leather halters  
Show stick  
Hair oil  
Clippers  
Thinning shears  
Water bucket  
Feed boxes  
Grooming chute  
Fans  
Hair dryer

{Teachers:

- ... Summarize major equipment needed to show beef cattle and the uses each has

#### PREPARING A BEEF ANIMAL FOR SHOW

{Teachers:

- ... Introduce topic of "Preparing a Beef Animal for Show"
- ... Identify the key steps that are necessary to prepare beef cattle for show (Listed below)
- ... Present them to the class in the form of a lecture
- ... Use slides, pictures, or overheads to illustrate points
- ... Use Handout - 3
- ... Be sure to include the list presented below.
- ... Summarize the problem by placing key findings on the board
- ... Have students place key findings in notebook

**A. Steps in Preparing a Beef Animal for Show**

1. Feet are trimmed so animal will stand squarely and walk properly.
2. Trim the hoofs lightly at any one time
3. Do not work on the feet immediately before a show
4. Clean, oil, or spray paint hoofs and dew claws before entering the show ring
5. Clip animals according to decrees of breed and type of animal (breeding or steer)
6. Clip 1 week before the show to avoid just clipped look
7. Trim underline 3 to 4 weeks before the show to make animal appear trimmer
8. Clip tail from high point of twist to the tailhead
9. Wash animal monthly until 6 weeks before show
10. Wash animal weekly the last 6 weeks before the show
11. Rinse off animal to remove all traces of soap
12. Curl the body hair by pulling up hair all over the body, then clipped down to the desired length, so as to shape the animal properly
13. "Bone" the animal with a limited amount of saddle soap or butch wax between the knee and ankle of the front legs and between the hock and the ankle of the hind leg, then comb the hair so that it stands straight out from the leg
14. Clean and fluff the switch
15. Oil the animal after "boning" and "teasing" with a hair dressing

{Teacher:

... Summarize key steps the student will need to take in preparing a beef animal for show

#### GUIDELINES FOR CONDUCT IN SHOW RING

{Teachers:

... Introduce topic with a comical role play of types beef cattle showmen. One has never shown an animal before and makes all types of mistakes. The other is a polished, professional showman.

... Identify the weaknesses associated with showman #1 and the strengths of showman #2

... Use slides, pictures, or overheads to further illustrate your points

... Use Handout - 4

... Include points included in list below

... Summarize the points and be sure to discuss the importance of each item.}

#### A. Basic guiding principles used by successful cattle showmen

1. Train the animal long before entering the show ring
2. Have the animal carefully groomed and parade before the judge
3. Dress neatly for the occasion
4. Enter the ring promptly when the class is called
5. Lead animal from the left side with the halter strap in right hand
6. When asked to line up, go quickly but not brashly
7. When stopped pose animal correctly

8. Stroke the animal along the back or under the belly while posing
9. When the judge handles your animal, react properly
10. Keep one eye on the judge and one on the animal
11. Never stand so that you block the judge's view
12. Keep calm and collected
13. Be courteous and respect the rights of other exhibitors
14. Do not speak to the judge unless he asks you questions
15. Be a good sport

#### Summary

Summarize the key points of this unit with the use of the list of approved practices (Attached). The students will place this list of approved practices in their notebook. Refer to the items in the interest approach to summarize key points covered in this unit.

#### Approved Practices

1. Lead animal from the left with the rope in the right
2. Train to pose on all four feet
3. When posing the animal, hold the strap in the left hand and face toward the animal.
4. A show stick is used in placing the hind feet of the animal but the showman's foot is best used in obtaining correct placement on the hind feet.
5. Feet are trimmed so animal will stand squarely and walk properly.
6. Clean, oil, or spray paint hoofs and dew claws before entering the show ring



7. Clip animals according to decrees of breed and type of animal (breeding or steer)
8. Clip 1 week before the show to avoid just clipped look
9. Trim underline 3 to 4 weeks before the show to make animal appear trimmer
10. Clip tail from high point of twist to the tailhead
11. Curl the body hair by pulling up hair all over the body, then clipped down to the desired length, so as to shape the animal properly
12. "Bone" the animal with a limited amount of saddle soap or butch wax between the knee and ankle of the front legs and between the hock and the ankle of the hind leg, then comb the hair so that it stands straight out from the leg
13. Clean and fluff the switch
14. Oil the animal after "boning" and "teasing" with a hair dressing
15. Have the animal carefully groomed and parade before the judge
16. Dress neatly for the occasion
17. Enter the ring promptly when the class is called
18. Stroke the animal along the back or under the belly while posing
19. When the judge handles your animal, react properly
20. Keep one eye on the judge and one on the animal
21. Never stand so that you block the judge's view

References:

Ensminger, M. E. (1976). Beef cattle science.  
Danville, Illinois: The Interstate Publishers,  
Inc.

**APPENDIX O**

**"PREPARING BEEF CATTLE FOR SHOW:"  
HANDOUTS AND OVERHEAD MASTERS**

## HANDOUT - 1

## Training and Grooming For The Show

Breaking an animal to lead and pose takes a patient, firm, and persistent individual. This task takes time and should be started when the animal is small and well before the show. The task of breaking the animal to lead is started by petting and brushing the animal. You want to get the animal accustomed to you. This can occur during the feeding period. After the animal is gentled a halter may be placed on the animal. The rope halter should be secured to a solid object such as a fence post the first time it is placed on the animal. The animal will resist the halter for a period of time. Start the animal to lead by having one person use the halter and another person walk behind the animal. The person leading the animal, leads from the left of the animal with the rope in the right hand. Care should be taken to insure that the animal never breaks away from the person leading it. The animal should be trained to respond exactly to the owners directions with the halter.

Once the animal has been broken to lead, the task of training the animal to pose properly begins. The animal should be trained to stand squarely on all four

feet. The showman should try to "set the animal up" where the front feet are slightly higher than the rear feet. The back of the animal should be held perfectly straight. This is accomplished by scratching the belly of the animal with a show stick. The head should be level with the top of the animal's back. The showman will move the halter rope or strap from their right hand to their left hand and face the animal while posing the animal. A show stick is used to place the animal's rear feet squarely under its body while the showman's feet are best used to secure placement of the front feet. This position could be strained and unnatural for the animal. After working with the animal it should be possible to "pose" the animal for fifteen to twenty minutes.

References:

Ensminger, M. E. (1976). Beef cattle science.  
Danville, Illinois: The Interstate Publishers, Inc.

HANDOUT - 2

Study Questions:

What care will be taken of the animals feet?

What steps are needed to groom an animal for show?

## HANDOUT - 3

## Preparing a Beef Animal For The Show

## Trimming the Feet

The feet of the animal should be trimmed regular in order that the animal will stand squarely and walk properly. Long toes are unsightly in appearance. Trimming can be accomplished with the animal in a set of stocks or on a trimming table. The feet of some animals should be trimmed regularly as often as every two months. The hoofs should be trimmed lightly at any one time. Any heavy trimming can result in lameness of the animal. The hoofs should not be trimmed immediately before the show to avoid the possibility of lameness. An electric sander, chisel, nippers, farmer's knife, and rasp may be used to trim the hoofs. It is not necessary to have all of this equipment available every time you trim an animal's hoofs. If the hoofs become dry from being kept constantly in a stable, a number of methods may be used to cure and prevent this from happening. The animal could be released on pasture at night. An application of neat's-foot-oil will also be helpful.

Before the animal is taken in the show ring a number of steps should be taken with the hoofs. The

hoofs and dew claws should be cleaned and oiled. Sometimes a coat of colored spray paint may be used. (Caution: An individual should check with local show regulations to determine if spray paint is legal for the show.)

#### Grooming the Animal

Animals intended for show should be brushed at least 15 minutes twice a day. The vigorous brushing stimulates circulation in the hide, removes dead hair, dirt, and dandruff, and induces the hair to grow. Short-haired animal should be brushed downward and to the rear with the lay of the hair. Long-haired animals should be brushed downward and then upward in the opposite direction of the lay of the hair.

Beef animals should be clipped according to decrees of the breed and type of animal being shown. (Figure 1)

Figure 1

#### Steers:

1. All tails clipped
2. All heads clipped, but do not clip the ears.

#### Breeding Cattle:

1. Angus- Heads ( but do not clip the inside or outside of the ears) and tails clipped.
2. Shorthorn - Neither heads or tails clipped
3. Herefords - Tails clipped, heads not clipped

The animal should receive the final clipping one week before the show to avoid that "just clipped" look. The underline should be clipped three to four weeks before the show. The trimming of the underline will make the animal appear trimmer. Animals with long hair will look better if they are "blocked" or clipped over the top and sides. The blocking is done at home, but the finishing touches is done at the show after the final washing. The tail is clipped from the high point of the twist to the tailhead.

The animal should be washed at least one a month until six weeks before the show. During the last six weeks before the show the animal should be washed weekly. Be sure to wash all traces of soap from the animal because it will leave dandruff. Avoid getting soap in sensitive areas such as eyes and ears.

Cattle with long hair should be curled. The hair is pulled up all over the body, then clipped to the proper length, so as to shape the animal properly. Experienced showman will vary the method and type of curling according to the individual animal. They will give consideration to the conformation and condition of the animal.

The legs of the animal are "boned" to give the appearance of a heavy boned animal. The legs are boned



by applying a limited amount of saddle soap or butch wax between the knee and ankle of the front leg and between the hock and ankle of the hind leg. Comb the hair so it stands straight out from the leg. "Boning" can also be used to make crooked legs appear straighter.

About an hour or two before the show the switch should be fluffed by combing it upward a few strands at a time. Tease the hair just as girls do. Hair spray can be used to hold it in place.

After "boning" the legs and fluffing the tail, the animal should be oiled. A mixture of equal parts glycerine, sweet oil, and rubbing alcohol may be used. After curling, boning, and teasing apply a light, even coat of oil to the animal with a hand sprayer. It should be remembered that the animal should not be shown when the hair is shiny or gummy from too much oil.

References:

Ensminger, M. E. (1976). Beef cattle science.  
Danville, Illinois: The Interstate Publishers, Inc.

## HANDOUT - 4

## Showing Beef Cattle

Every show presents a set of different circumstances. A professional showman will take these circumstances and use them to their advantage. There is no written set of guidelines to insure success in showing beef cattle, but a few guidelines will be presented that will guide the amateur showman.

Have the animal trained a long time before the animal enters the show ring. The animal should be properly gentled and trained. Have the animal groomed and parade before the judge. Use the ring to your advantage in presenting your animal to the judge. Keep one eye on your animal and one eye on the judge at all times. Dress neatly for the occasion. Some shows will have dress codes. Be sure to follow the guidelines of the show you are participating in.

Have the animal groomed and be prepared to enter the show ring when your class is called. Lead the animal from the left side, walking near the left shoulder of the animal, and with the halter strap in your right hand. A show stick should be carried in your left hand. When the judge asks or motions you to line up, do so quickly but not brashly.

When you are stopped set-up your animal and pose it so as to minimize its faults. Take the strap in the left hand and the show stick in your right hand. Start setting up your animal by setting the rear feet first. Keep the animal's head up and alert. The back of the animal may be kept straight by scratching the belly of the animal with your show stick.

When the judge handles your animal react accordingly. If your animal is overfinished, pull the head of the animal away from the judge to give the appearance of a more firm finish. If the animal is light in its finish, pull the animal's head toward the judge to give the appearance of a softer finish. As soon as the judge leaves, use a scotch comb to restore the animal's finish to the hair. Never stand where you block the judge's view of the animal.

It is work for an animal to pose for long periods of time. It is possible to let the animal stand at ease when the judge is working the far end of the ring of a large class of animals. Keep calm and collected. Be courteous and respect the rights of the other exhibitors. Do not speak to the judge except to answer a direct question from the judge. Above all be a good sport.

References:

Ensminger, M. E. (1976). Beef cattle science.  
Danville, Illinois: The Interstate Publishers, Inc.

APPENDIX P

"PREPARING BEEF CATTLE FOR SHOW:"  
TEST QUESTIONS

## PREPARING BEEF CATTLE FOR SHOW TEST QUESTIONS

Instructions: Read each question carefully. Select the most correct answer. Place the letter of the correct answer in the space provided to the left of the number of the question.

- \_\_\_ 1. Hoofs should be trimmed closely so that they do not have to be trimmed as often.
- A. True  
B. False
- \_\_\_ 2. Cutting hoofs too close can result in the animal catching foot and mouth disease.
- A. True  
B. False
- \_\_\_ 3. Hoofs can be trimmed so that calves that stand with their feet pointed out will stand with their feet straight.
- A. True  
B. False
- \_\_\_ 4. Cutting a hoof too close can damage the hoof and make the calf temporarily lame.
- A. True  
B. False
- \_\_\_ 5. It is best to clip an animal one month prior to the show so the animal does not have that "just trimmed" look.
- A. True  
B. False
- \_\_\_ 6. One of the best ways to gentle a calf is to tie it behind the drawbar of a tractor and lead it.
- A. True  
B. False
- \_\_\_ 7. Washing an animal's hair frequently, improves the quality of the hair.
- A. True  
B. False

- \_\_\_\_\_ 8. When combing a calves hair, a student should always brush the hair up to train the hair.
- A. True  
B. False
- \_\_\_\_\_ 9. Calves are often tilted on their side when hoofs are trimmed.
- A. True  
B. False
- \_\_\_\_\_ 10. Preparing a Brahman calf for show is like cleaning a polyester shirt, you just wash them and let them drip dry.
- A. True  
B. False
- \_\_\_\_\_ 11. It is important to make steers look feminine and heifers look masculine when grooming the animals before show.
- A. True  
B. False
- \_\_\_\_\_ 12. Heavy-boned animals are considered to have more muscling and are more desirable over fine-boned animals.
- A. True  
B. False
- \_\_\_\_\_ 13. Calves used to being around people are not as shy or nervous when taken to a show for the first time.
- A. True  
B. False
- \_\_\_\_\_ 14. It is important to chew gum in the show ring when exhibiting your calf.
- A. True  
B. False
- \_\_\_\_\_ 15. An animals legs are "boned" to give the appearance that the animal is heavy-boned.
- A. True  
B. False

- \_\_\_ 16. It is important to feed, water, and wash the calf after the show.
- A. True
  - B. False
- \_\_\_ 17. Trimming the hoofs:
- A. Improves the appearance of the animal
  - B. Can be used to correct the stance of the animal
  - C. Should be done several weeks before the show
  - D. Both A and C are correct
  - E. A, B, and C are correct
- \_\_\_ 18. "Boning" the animal should occur the day of the show.
- A. True
  - B. False
- \_\_\_ 19. The proper way to set up the rear legs of the animal is with a show stick.
- A. True
  - B. False
- \_\_\_ 20. Keeping the animal calm in the show ring might be accomplished by:
- A. Leading from the left side
  - B. Stroke the animal along the back or belly
  - C. Circle the animal often
  - D. Allow animals to set up on their own
- \_\_\_ 21. What equipment would you consider using to trim a beef animals hoofs?
- A. Knife
  - B. Rasp
  - C. Chisel
  - D. All of the above

- \_\_\_\_\_ 22. The hoofs of your beef animal have become very dry and brittle. What can you do to correct the situation?
- A. Turn the animal out on pasture at night
  - B. Apply neat's-foot oil to hoofs
  - C. Pack the hoofs with wet clay
  - D. All of the above
- \_\_\_\_\_ 23. Which of the following is not a result of vigorous brushing?
- A. Stimulates circulation of the hide
  - B. Removes dandruff, dirt, and dead hair
  - C. Removes natural oil in hair
  - D. Induces the hair to grow
- \_\_\_\_\_ 24. The primary purpose of a curry comb is:
- A. Improve natural oil in hair
  - B. Reduces growth of hair
  - C. Removes clinging particles that cannot be taken out with a brush
  - D. Thin out dead hair
- \_\_\_\_\_ 25. The head of a steer is usually clipped.
- A. True
  - B. False
- \_\_\_\_\_ 26. "Blocking" refers to clipping the animal:
- A. Over the top and down the sides
  - B. On the underline
  - C. On the tail between the twist and tailhead
  - D. On the face and between the ears
- \_\_\_\_\_ 27. You have an animal that appears heavy in the belly area. What can you do to improve the appearance of the animal and hide the heavy belly?
- A. Block the animal on the top and sides
  - B. Trim the underline three to four weeks before the Show
  - C. Trim the tail between the twist and the tailhead
  - D. Curl the hair parallel to the underline



- \_\_\_ 28. The animal should be rinsed very thoroughly after each wash to:
- A. Remove all traces of soap from the hair
  - B. Prevent dandruff on the animal
  - C. Keep the animal from contracting a respiratory infection
  - D. A and B above
- \_\_\_ 29. The method or type of curling is determined by:
- A. Length of hair
  - B. Whether hair is straight or curly
  - C. Conformation and condition of the animal
  - D. All of the above
- \_\_\_ 30. You animal has "sickle-hocked" legs. (Their hind legs extend too far forward) What would be a logical step to hide the defect?
- A. Correct "boning" procedures
  - B. Trimming the hoofs
  - C. Proper clipping of the legs
  - D. None of the above
- \_\_\_ 31. The purpose of grooming a beef animal is to:
- A. Hide defects
  - B. Improve the animals appearance
  - C. Catch the eye of the judge
  - D. All of the above
- \_\_\_ 32. A beef animal is lead with the halter strap in the \_\_\_\_\_ hand.
- A. Right
  - B. Left
- \_\_\_ 33. The animal is posed with the halter strap in the \_\_\_\_\_ hand.
- A. Right
  - B. Left

- \_\_\_\_\_ 34. Your animal is a little over finished. The judge is approaching your animal. What should you do?
- A. Turn the animal's head away from the judge
  - B. Turn the animal's head toward the judge
  - C. Hold tightly to the halter strap
  - D. Set the animal so the judge will not be able to see the problem
- \_\_\_\_\_ 35. After the judge touches your animal, you should:
- A. Shake the show strap to keep the animal alert
  - B. Brush the area where the judge handled the animal
  - C. Do nothing
  - D. Lead animal in a tight circle and set it up again
- \_\_\_\_\_ 36. A beef showman will walk \_\_\_\_\_ when showing a beef animal
- A. Backward
  - B. Forward
- \_\_\_\_\_ 37. If the show ring has a high point near where you plan to stop your animal. What would a wise showman do?
- A. Place the animal's front feet on the high point
  - B. Place the animal's rear feet on the high point
  - C. Avoid the high point
  - D. Have the animal straddle the high point
- \_\_\_\_\_ 38. You feel hemmed in by the other animals. The judge has not asked you to hold your position. What do you do?
- A. Ask your neighbor to move over
  - B. Move to another location
  - C. Stay where you are
  - D. Step away from the other showman

- \_\_\_\_\_ 39. It is proper to talk to a judge under the following conditions.
- A. When the judge approaches the animal
  - B. When the judge touches the animal
  - C. When the judge moves away from the animal
  - D. None of the above
- \_\_\_\_\_ 40. A showman should be courteous and respect the rights of other exhibitors.
- A. True
  - B. False

**APPENDIX Q**

**"PREPARING BEEF CATTLE FOR SHOW:"  
ATTITUDE INSTRUMENT**

INSTRUCTIONS FOR ATTITUDES  
TOWARD TEACHING METHODS INSTRUMENT

INSTRUCTIONS TO TEACHERS: Please administer this instrument as soon as possible after the completion of the achievement test on the unit of instruction. Make sure that all students have adequate time to complete all of the items on the questionnaire.

Have a student collect the papers and place them in the envelope to be mailed to me. I will provide you a summary of their responses.

READ THESE INSTRUCTIONS TO THE STUDENTS:

1. This questionnaire is to determine how you felt about the way the last unit was taught. You will consider only how the last unit was taught and not how the entire course has been taught.
2. This is not a test. Please answer each item according to your opinion of the way the unit was taught.
3. SOME OF THE STATEMENTS ARE NEGATIVE STATEMENTS! Keep in mind that marking STRONGLY AGREE will not always mean that you liked the teaching method. It is important that you read each statement carefully.
4. Answer each question honestly. The purpose of this questionnaire is to determine your opinions. There is no right or wrong answer.
5. Complete confidentiality will be observed.

## ATTITUDE TOWARD TEACHING METHODS

This instrument has been prepared so that you can share your opinions about the methods used to teach the last unit. Teaching method refers to the way the class was conducted. PLEASE RESPOND TO EVERY ITEM. In each case draw a circle around the letter which represents your own reaction to the item. The letters in the questionnaire represent the following statements:

- SD if you STRONGLY DISAGREE with the statement  
 D if you DISAGREE, but not strongly so  
 N if you are NEUTRAL or UNDECIDED  
 A if you AGREE, but not strongly so  
 SA if you STRONGLY AGREE with the statement

Remember, the only correct answer is the one which actually represents how you felt about the unit that was just completed.

- |  | Circle Your Response |
|--|----------------------|
| 1. I enjoyed the methods used in teaching the unit.  | SD D N A SA          |
| 2. I liked this method for teaching this unit better than other methods my teachers have used. | SD D N A SA          |
| 3. I feel that I did not learn much about the topic.   | SD D N A SA          |
| 4. The methods used to teach this unit did not make the topic very interesting.                | SD D N A SA          |
| 5. The "Preparing Beef Cattle for Show" unit gave me real enthusiasm for the topic.            | SD D N A SA          |
| 6. The method of instruction was very challenging to me.                                       | SD D N A SA          |
| 7. I wish that other classes were taught using the teaching method used for this unit.         | SD D N A SA          |

PLEASE RESPOND TO EVERY ITEM. In each case draw a circle around the letter which represents your own reaction to the item. The letters in the questionnaire represent the following statements:

SD if you STRONGLY DISAGREE with the statement  
 D if you DISAGREE, but not strongly so  
 N if you are NEUTRAL or UNDECIDED  
 A if you AGREE, but not strongly so  
 SA if you STRONGLY AGREE with the statement

| Circle Your Response |

8. There was not as much student participation as there should have been. SD D N A SA
9. I learned more because of the teaching methods used for this unit. SD D N A SA
10. The method of instruction for this unit did not give me enough freedom to express ideas. SD D N A SA
11. The class sessions were enjoyable. SD D N A SA
12. The method of instruction encouraged me to develop my own conclusions concerning the topic. SD D N A SA
13. I am not motivated to work as hard when this method is used. SD D N A SA
14. As a result of the teaching method, I feel confident that I can use what I learned about the topic when I have the opportunity. SD D N A SA
15. Compared to other teaching methods, I felt like I had less responsibility for what I learned when this teaching method was used. SD D N A SA

APPENDIX R  
PROBLEM SOLVING APPROACH TO TEACHING  
UNIQUE FEATURES



Problem Solving  
as an Approach to Teaching

The problem solving approach has been widely accepted as the way to teach vocational agriculture. Variations of the problem solving approach have been recommended by agricultural educators since its inception in 1917 (Binkley and Tulloch, 1981; Crunkilton and Krebs, 1982; Hammonds, 1950; Krebs, 1967; Lancelot, 1944; Stewart, 1950; and Newcomb, McCracken, and Warmbrod, 1986). John Dewey, an educational philosopher, defined a scientific method of teaching which combined ideation with overt muscular acts. The problem solving approach has been relatively unchallenged as the method of instruction in vocational agriculture programs (Moore and Moore, 1984).

Why has the problem solving approach to teaching been so widely accepted as the method of teaching vocational agriculture? What makes the problem solving approach an unique approach to teaching high school vocational agriculture students? This paper will address the issue of what are the unique features of the problem solving approach.

John Dewey identified a six step learning process that has offered the framework on which the problem solving approach has been based. This process known as

Dewey's Steps in Reflective Thinking, The Method of Science, The Learning Process, and The Scientific Method parallels the Six Step Problem-Solving Approach to Teaching identified in Methods of Teaching Agriculture (Newcomb, McCracken, and Warmbrod, 1986). The six steps in Dewey's Steps in Reflective Thinking are: 1) Experiencing a provocative situation, 2) Defining the problem, 3) Seeking data and information, 4) Formulating possible solutions, 5) Testing proposed solutions, and 6) Evaluating the results. There are several factors that make the problem solving approach to teaching unique. These factors hinge around the use of the scientific approach to teaching.

The problem solving approach uses real problems as the basis for the lesson plan. The real problems provide for direct involvement of the students in the lesson planning. The instructor will take a provocative situation and present in it such a way that the situation becomes a personal problem for the students. The fact that the situation has a personal appeal to the students gives the students motivation to learn and to inquire into the situation. The teacher has developed a felt-need-to know in the students.

The teacher will explore the provocative situation with the students. The situation will be

probed with a variety of well designed questions. The end result will be a clear-cut statement of the problem by the students in the class.

Once the problem has been clearly identified, the students will discover possible solutions to the problems. Possible solutions are drawn from the students using key words carefully placed into strategically designed questions. Each potential solution must be a potential solution to the problem and must be clearly and properly stated.

Once potential solutions are established for the problem the students need to determine what factors will be considered in accepting a possible solution. When the factors needed to analyze the potential solutions are identified, the students will find and interpret information needed to analyze potential solutions to the problem. The information is weighed to determine its significance to the situation being considered. After weighing the evidence the students will come to a conclusion to the problem. Evidence must be presented as to why the solution is the correct one.

Once the solution to the problem is established the students will implement the solution. The results of the solution will be evaluated and the success and/or failure discussed by the students. The evaluation will

lead to a satisfactory solution to the problem or result in another problem being identified and the process started over again.

The key that makes the problem solving approach to teaching unique is the use of the scientific method of problem solving by students to solve real everyday problems. Students will start with a real situation, clearly identify and state the problem, discover potential solutions to the problem, analyze the potential solutions, identify the best solution to the problem, implement the solution, and evaluate the results of the solution on the problem.

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APPENDIX S  
EVALUATION OF TEACHING APPROACHES  
INSTRUMENT

**EVALUATION OF APPROACHES USED TO TEACH  
HIGH SCHOOL VOCATIONAL AGRICULTURE STUDENTS**

This instrument has been prepared to evaluate the approach(es) used to teach high school vocational agriculture students. Please circle the letter that best represents your evaluation of each of the following items. The numbers in the instrument represent the degree the item is present in the teaching performance with a (1) representing the absence of the item and a (7) representing a strong presence of the item in the teaching performance.

**TO WHAT EXTENT:**

	Circle Your Response							
1. Was the instruction organized around solveable problem statements?	1	2	3	4	5	6	7	NA
1A. Was there an answer to the problem statements?	1	2	3	4	5	6	7	NA
1B. Was there more than one answer to each problem statement	1	2	3	4	5	6	7	NA
1C. Was the problem statement true-to-life (real)?	1	2	3	4	5	6	7	NA
2. Was the problem statement explored by the students?	1	2	3	4	5	6	7	NA
2A. Were a variety of questions used to explore the context and bring out the problem?	1	2	3	4	5	6	7	NA
3. Did the class develop a clear-cut statement of the problem?	1	2	3	4	5	6	7	NA
4. Did students help discover possible solutions to the problem(s)?	1	2	3	4	5	6	7	NA
4A. Were possible solutions drawn from the class using key words or questions?	1	2	3	4	5	6	7	NA

## TO WHAT EXTENT:

	Circle Your Response							
4B. Was each solution a potential answer to the problem?	1	2	3	4	5	6	7	NA
5. Did the class discover what factors needed to be considered in accepting a possible solution?	1	2	3	4	5	6	7	NA
6. Did students find and interpret information needed to analyze the potential solutions to the problem?	1	2	3	4	5	6	7	NA
Were the class members helped by the teacher to progress toward a solution to the problem "on their own?"	1	2	3	4	5	6	7	NA
7. Were students helped to weigh and process the information gathered to determine its significance to the situation being considered?	1	2	3	4	5	6	7	NA
8. Did the class discuss and arrive at a tentative (assumed best) conclusion to the problem?	1	2	3	4	5	6	7	NA
9. Was the solution to the problem implemented under the teachers guidance?	1	2	3	4	5	6	7	NA
10. Were the results of the solution evaluated and success and failure of the solution discussed?	1	2	3	4	5	6	7	NA



## DATA ANALYSIS:

ITEM	WEIGHT	SCORE		
SCORE 1	_____	x .04	=	_____
SCORE 1A	_____	x .02	=	_____
SCORE 1B	_____	x .02	=	_____
SCORE 1C	_____	x .02	=	_____
SCORE 2	_____	x .07	=	_____
SCORE 2A	_____	x .03	=	_____
SCORE 3	_____	x .10	=	_____
SCORE 4	_____	x .06	=	_____
SCORE 4A	_____	x .02	=	_____
SCORE 4B	_____	x .02	=	_____
SCORE 5	_____	x .10	=	_____
SCORE 6	_____	x .10	=	_____
SCORE 7	_____	x .10	=	_____
SCORE 8	_____	x .10	=	_____
SCORE 9	_____	x .10	=	_____
SCORE 10	_____	x .10	=	_____
TOTAL	_____			_____

(TOTAL SCORE / TOTAL WEIGHT) =  
ADJUSTED SCORE

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