EXPERIMENTAL EVALUATION OF FIELD TRIPS ON INSTRUCTION IN VOCATIONAL AGRICULTURE

by

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INTRODUCTION

The field trip is one of the many instructional techniques that classroom teachers have used in their instructional programs. The exact origin of the field trip is not known, however, there are numerous references to them in the literature. According to Kinder (24), Herodotus and Xenophan, Greek peripatetic teachers who traveled abroad to gain their knowledge of peoples and lands, were among the earliest users of field trips. Other early users included the Roman scholars who traveled widely in Rhodes, Greece, Egypt, and elsewhere. In the eighteenth and nineteenth centuries, Comenius, Rousseau, and Froebel were three famous educators who advocated the field trip as a valuable learning procedure. Johann Heinrich Pestalozzi, the great Swiss teacher, also advocated observation and experimentation as a meaningful teaching method. England, Germany, Fascist Italy, and Soviet Russia were among the first countries to show interest in the field trip. Poland, France, Holland, Scandinavia, and Japan advocated the use of field trips to a lesser extent.

One of the earliest recorded field trips was taken in 1877 when a class in England went to Switzerland to study glacial formations. The English use of field trips was considered more as a supplement to the regular instruction, whereas, the Germans used it as the method of instruction. In the United States, early advocators of the field trip included Franklin and Jefferson. They suggested that farmers travel to neighboring plantations to view the farming methods being used there. Francis Parker, Charles and Frank McMurray, John Dewey, and Harold Rugg were among the Americans to advocate the use of field trips.

The use of field trips in the teaching of vocational agriculture is not new. When vocational agriculture began in 1917 and students were usually enrolled for one-half day classes, it was quite easy to use field trips. Later, the time for vocational agriculture classes was reduced to two hours each day, but teachers were still able to take a field trip; and the students could return to school in time for their next classes. In time, most high school classes of vocational agriculture were changed to a 55 minute period and the teacher was required to plan carefully if he intended to use field trips. Improved transportation facilities in the local school and better roads in the community made field trips to points outside of the classroom a feasible instructional technique even though the length of the class period had been substantially reduced.

Most teachers of vocational agriculture have found field trips to be desirable techniques and have included them in their instructional programs. One of the reasons for the importance of field trips in the teaching of vocational agriculture has been that most communities have had excellent farmers and agricultural businesses and industries that provided many opportunities for the student to observe and study. In addition, the four instructional areas of the vocational agriculture curriculum of animal science, agronomic science, agricultural mechanics, and agricultural economics have allowed the teacher to utilize the facilities already available in the community.

Field trips have also been included in the method courses in teacher education programs in agriculture. Teacher educators have suggested and encouraged the use of field trips as methods of combining the facts and theory of the classroom with the practices of life itself. Teacher educa-

tors have also stressed the importance of the field trip in integrating the school and the community.

There are many advantages to using field trips as an instructional technique. Morgan, Holmes, and Bundy (29, p. 134) listed the following advantages of field trips:

1. They provide opportunities for gaining new experiences and information.
2. Objects may be observed in their natural settings.
3. Three dimensions, natural color, and movements may be observed.
4. Member interest and keenness of observation may be stimulated.
5. Opportunity may be provided for participants to learn by doing.
6. Procedures may be observed and experienced which the participants may later duplicate.
7. They provide an opportunity to integrate school or organizational activity with community life.
8. Concrete and realistic elements may be provided that cannot be had in the classroom or regular meeting place.
9. They provide a sense of reality to problems of adult nature.
10. They may make possible the understanding of ideas that are difficult to transfer from group leaders to participants.
11. When properly carried out, they are cooperative projects which tend to develop a unity of purpose among participants.
12. They may serve excellently to stimulate members to participate in discussions and activities following the trip or tour.

Underlying every instructional method and technique is some particular educational theory and commitment to a particular psychology of learning. The methods and techniques of instruction selected by the teacher tend to reflect the particular theory that has appealed to him most. Dale (13, p. 136) lists the educational theory underlying field trips as:

> ... you discover what something means by responding actively to it. You see it in operation. You cannot learn what something means merely by looking it up in a dictionary or encyclopedia and then repeating what was said there. You can, it is true, get some of the meaning this way. But the richer our direct experience with each of the words used in this definition, the more meaningful that definition will be. And the more meanings we can

bring to any experience the more meaning we can get out of it.

> ... Meanings, then, do not hit the eye-ready made. Our richest experiences and thus our richest meanings come only when we respond both physically and mentally to a new situation.

Throughout the author's experience as a vocational agriculture teacher he felt a definite need to involve his students in class activity as much as possible. Field trips seemed to provide one opportunity for student involvement and, through their use, his students could become motivated and find direction in the instruction that was being presented. Field trips also presented one method whereby the students could respond both physically and mentally to the material being presented by the teacher. The theory behind this view has been stated by Postlethwait, Novak, and Murray (31, p. 1):

> The structuring of an educational system should be done on the basis that the program must involve the learner. The teacher at best can only create a situation conducive to learning by providing the direction, facilities and motivation to the individual learner.

One of the major problems encountered with the use of field trips as an instructional technique has been that teachers have failed to prepare their classes for the field trip. Many times the field trip has been used as an excuse to get out of the classroom and the teacher has not had to worry about the classroom presentation to be made during that particular period. Kinder (24, p. 389) listed the following reasons for sporadic and haphazard use of field trips:

1. the tradition of the "reading school"
2. unfamiliarity of teachers with the school journey as an instructional technique
3. absence of an emphasis on the school journey in the program of the teacher education institutions
4. the inflexibility of school programs
5. wide family travel

6. the use of radio and motion pictures
7. the general educational philosophy of the community.

Kinder (24, p. 389) concludes his statement on why field trips have not been used more extensively by stating, "In the main, American schools are book-centered rather than life-centered."

Although most educators agree that the field trip has been an effective instructional device, little has been done to evaluate the effect of field trips on student achievement. Those teachers who have used field trips have either liked the response of the class to field trips or have accepted the idea that field trips were desirable instructional techniques. There are still several questions that need to be answered about field trips. Is the field trip an effective instructional technique in the teaching of vocational agriculture? Can field trips be used effectively in each of the four curriculum areas of vocational agriculture? What effects do interests, abilities, and aptitudes have on students taught with the aid of field trips? What effects do teacher characteristics have on students taught with the aid of field trips? Is class size a factor on students taught with the aid of field trips? The general purpose of this study was to determine the effect of field trips on student achievement in each of four subject matter areas of vocational agriculture. The specific objectives were the following:

1. To determine the effect of field trips on student achievement in specific units in each of the four curriculum areas in the vocational agriculture program: animal science, agronomic science, agricultural mechanics, and agricultural economics.
2. To determine the effect of field trips on student achievment when

certain academic ability factors are controlled.

3. To determine the effect of field trips on student achievement when certain interest factors are controlled.
4. To determine the effect of field trips on student achievement when certain aptitude factors are controlled.
5. To determine the effect of field trips on student achievement when certain socio-economic factors are controlled.
6. To determine the effect of field trips on student achievement when certain teacher factors are controlled.
7. To determine the effect of field trips on student achievement when certain school factors are controlled.
8. To determine the effect of field trips on student achievement when certain student, home, school, and teacher factors are controlled.

This study was conducted by the author in cooperation with the Department of Agricultural Education and the Iowa Agriculture and Home Economics Experiment Station of Iowa State University, The Vocational Agriculture Section of the Department of Public Instruction and the Iowa Section of the Research Coordinating Unit under a research grant from the Vocational Education Branch (VEA-1963-1964 (a) Ancillary Funds) Iowa Department of Public Instruction. This study was a part of a larger study entitled, "An Experimental Evaluation of the Effectiveness of Selected Techniques and Resources on Instruction in Vocational Agriculture."

It is hoped that the information gained from this study will provide guidance for vocational agriculture teachers, school administrators, teacher educators, and other educational personnel in the use of field trips.

REVIEW OF LITERATURE

A review of literature revealed a large amount had been written about field trips but very little experimental evidence was available as to their effectiveness. In the literature related to this study, four general categories appeared as being appropriate. Consequently, this review has been divided into the following parts: (1) the use of field trips, (2) the structure of field trips, (3) studies in agricultural education, and (4) studies in related areas.

The Use of Field Trips

Field trips were defined by Dale (13) to be planned visits to points outside the regular classroom. These visits have been made for a variety of reasons, depending on the objectives of the teacher. Through the use of field trips the classroom can be taken into the community and the problems of the community can be brought back into the classroom.

Most textbooks on methods of instruction have a section dealing with the use of field trips. Phipps (30, p. 718) stated: "Field trips and tours have always been extensively used in agricultural education. They are an effective visual aid and must not be neglected as newer types of visual aids become available." The aims and purposes of field trips in agricultural education were stated by Phipps (30, p. 127) as follows:

1. It develops student interest.
2. It provides opportunities for gaining new experiences and information.
3. It provides opportunities for learning by doing--teaching on the job.
4. It relieves the monotony of classroom instruction.
5. It helps to develop understanding.

Delaney (16, p. 102) had the following to say about the use of field

trips: "Teachers commonly accept the field trip to be a means which local or community resources outside of the school and classroom are made available by means of first-hand experience." In another article, Delaney (15, p. 474) stated:

> The teacher ... uses field trips to introduce units of study, to catalyze and enrich units already in progress, or to serve as a culminating activity.

An article on conduct, knowledge, and acceptance of new values by Lewin and Grabbe (28, p. 56) has the following statements about teaching methods:

> We know that lectures or other similarly abstract methods of transmitting knowledge are of little avail in changing ... outlook and conduct. We might be tempted, therefore, to think that what is lacking in these methods is first-hand experience. The sad truth is that even first-hand experience will not necessarily produce the desired result.

Dale, Finn, and Haban (14, p. 277) have the following statement about experimental research on field trips:

> One of the developments in the audio-visual field relates to the community as a resource for teaching materials. Early studies often evaluated a field trip as contrasted with reading materials, a film, etc. Later studies have put more stress on making available a variety of resource material for class use. A significant movement for the development of such resource materials has focused around the Committee of Southern Regional Studies and Education which has headquarters at the University of North Carolina. This new approach to resource materials will probably displace the previous concern for discovering the value of one type of resource as contrasted with another. Our experimental concern in the future is likely to lie in studies of integrated use of all resources.

The average number of field trips in Iowa vocational agriculture departments for each school year 1957-1958 through 1967-1968 is shown in Table 1. The data used in compiling these figures were obtained from the Summary of Program Vocational Education in Agriculture (22). These data

Table 1. Average number of high school class field trips in Iowa by school year

School year	Total number of field trips	Number of vo. ag. departments	Average number of field trips per department
1957-1958	5,770	303	19.0
1958-1959	5,094	286	17.8
1959-1960	4,553	285	16.0
1960-1961	4,258	283	15.0
1961-1962	3,635	275	13.2
1962-1963	3,676	262	14.0
1963-1964	3,425	257	13.3
1964-1965	3,227	248	13.0
1965-1966	3,054	246	12.4
1966-1967	2,985	238	12.5
1967-1968	2,919	238	12.3

revealed that the average number of field trips has steadily decreased from a high of 19.0 in 1957-1958 to a low of 12.3 in 1967-1968.

The Structure of Field Trips

Field trips, like any well prepared lesson, need to be well planned and the objectives clear to both the student and teacher if they are to be effective. The basic steps in planning for field trips were listed by Grim and Michaelis (18, p. 232) as follows:

1. State and clarify the purpose of the field trip.
2. Make some general study of the problem under consideration.

3. Prepare questions to be answered by the trip.
4. Make all arrangements essential for the success of the trip.

Brown, Lewis, and Harcleroad (7, p. 364) state that there are three stages in carrying out a field trip: "(1) advance planning, (2) taking the trip, and (3) follow-up activities."

The five phases of field trips listed by Wittich and Schuller (37, p. 244) are as follows:

1. preliminary preparation,
2. preliminary discussion of study objectives,
3. observation,
4. follow-up discussion and evaluation,
5. follow-up projects growing out of the field trip.

Wittich and Schuller (37, p. 247) go on to state:

> The combination of anticipating learning problems and being given a clear-cut and definitive statement of the objectives to be achieved is the best preparation the learner can have in advance of the actual visit.

Some of the items that should be considered in the proper planning of a field trip were stated by Barrett (2) as follows: (1) the teacher and student should understand the purpose of the field trip, (2) there should be a reason for taking the trip, (3) field trips should be taken at appropriate times throughout the year, (4) the class should be familiar with the overall operation and scope of the place to be visited, (5) activities should be planned for the time going to and from the destination, (6) students should enjoy field trips and leave with the feeling that the experience was interesting and worthwhile, and (7) the follow-up to a trip is almost as important as the trip itself.

Studies in Agricultural Education

Jones (23) studied how teachers used field trips, the importance of factors which tend to limit the use of field trips, suggested ways and means of reducing limitations, and suggestions for improvement in the use of field trips. He sent questionnaires to 109 teachers of agriculture who were selected at random. His findings revealed that of nine teaching devices presented to teachers for comparison, field trips ranked second in importance. Teachers conducted on an average 32.3 field trips per year. Field trips were considered an excellent device for teaching jobs requiring manual skill by 50 percent of the teachers. A majority of the teachers reported that field trips were an excellent method for creating interests. The main factors limiting the taking of field trips were: transportation, length of class period, size of class, and lack of funds to operate vehicles. Some of the factors affecting the success of field trips included: purposes to be made definite and clear, proper courtesies be extended to person at place visited, preliminary arrangements be made, summarization, and conclusions drawn to be discussed before the class.

In a study of procedures for using field trips in teaching vocational agriculture in Virginia, Carter (9) sent a questionnaire to a random sample of 125 teachers. He found that teachers conducted an average of 15.8 field trips per year. The most important reasons for taking field trips included: to provide opportunity for giving new experiences and information; to compare conclusions drawn in class with actual farm practices; to develop pupil understanding and interest; and to provide teaching on the job. In arranging schedules for field trips, 78 percent of the teachers made arrangements with the principal and other teachers whose classes might be

affected. The average length of the field trip conducted was two hours or less. Factors leading to successful field trips included: (1) keeping the group together, (2) securing permission of the farmer or owner and of school authorities, and (3) following up a field trip with student discussion and application. The factors limiting the success of field trips were (1) taking field trips not related to a unit being taught, (2) taking a field trip with little or no prior planning, (3) allowing students to drive their own cars, and (4) having someone else take the class. The difficulties encountered most often in taking field trips were: (1) lack of class time, (2) lack of adequate transportation, (3) schedule difficulties, and (4) distance too great from school to place of field trip.

Hutchinson (21) compared the effectiveness of field trips to a combination of conventional methods including lecture, supervised study, reading assignment, and use of weed plant mounts and seeds. Four different groups of weeds were presented to the same group of students using the two instructional procedures being studied. Methods were compared by utilizing the percentage differences between the mean student pre-test and post-test scores of each group. He found that the field trip method combined with the conventional method resulted in 4.35 percent less student comprehension than the conventional method alone.

A study of the factors influencing acquisition and retention of learning in vocational agriculture was conducted by Christensen (10) in 1961. The subjects used in this study were 481 sophomore students distributed through a ten percent random sample (33 schools) of all vocational agriculture departments in Wisconsin. The experimental method employed was to administer a pre-test to the students, present a classroom instructional unit

on swine care and management, then, measure their achievement by a post-test and lastly, measure their retention of swine knowledge after a 150 day time period.

The major findings of this study indicated that: (1) student ownership of one animal of the type being studied in the classroom was of benefit only in situations where none of the animals of the type being studied were on the home farm, (2) the scope of the livestock enterprise experience program had to be large enough to require managerial skill to measurably influence classroom learning, (3) the amount of first-hand experience had a greater influence on acquisition than on retention, (4) prior experience had more influence on gain in facts and figures than on the learning of scientific principles and ability to solve problems, (5) the level of occupational aspirations was a reflection of ability and an influential factor in learning, (6) aptitude had a greater influence on acquisition and retention than did any other factor studied, (7) a direct relationship existed between parental attitude toward vocational agriculture and acquisition and retention, (8) a good to excellent opportunity to farm appeared essential if the student was to approach maximum classroom learning and retention, (9) the largest measured gains in knowledge were made in facts and figures, (10) the highest measured retention resulted in the areas of scientific and technological information and problem solving, (11) aptitude influenced problem solving ability more than any other factors studied.

A study was conducted by Warren (35) to determine the opinions of veterans enrolled in the institutional on-farm training program concerning the value of audio-visual materials and methods, and the extent to which they should be used in an effective instructional program for adults. Data for

this study were collected by questionnaire from 50 randomly selected veterans' classes in each of 11 midwestern states. A total of 11,299 completed schedules were obtained from 536 classes.

Results of this study indicated that veterans ranked field trips as the second most important audio-visual material and method to be used in an effective instructional program. A highly significant chi-square value (58.97) was obtained when the value of field trips was compared with the rating of instructors. Veterans whose instructors rated average and below tended to rate the value of field trips to farms in the community higher than did veterans whose instructors were rated above average. Field trips ranked third in importance as an audio-visual material and method in an effective instructional program for veterans when rated by the instructors of these classes.

The purpose of a study by Thompson and Tom (33) was to compare the effectiveness of a pupil-centered versus a teacher-centered pattern of teaching vocational agriculture. Twenty-two teachers of vocational agriculture were selected from six counties in New York to participate in the experiment. Eleven teachers were placed in each the pupil-centered (experimental) and teacher-centered (conventional) groups. Each group of instructors then taught four units of instruction from the dairy enterprise to their tenth grade pupils. A dairy enterprise test and an attitude toward farming scale were administered both as a pre-test and post-test. A test in solving dairy problems was administered as a post-test only. Results of this study indicated that students taught by the pupil-centered approach scored significantly higher than those taught by the teacher-centered approach on the dairy enterprise test in nine of thirteen comparisons. No significant

differences were observed in change in attitude toward farming between pupils in the two patterns of teaching for any of the categories compared. Those students who had an opportunity to farm had a significantly higher mean score on the test in solving dairy problems when taught by the student-centered method than those taught by the teacher-centered method. Thompson and Tom (33, p. 677) concluded:

> ... since the "experimental" pattern of teaching was superior in developing the ability to recall factural material, was comparable to "conventional" in bringing about change in attitude toward farming, was also comparable to the "conventional" in developing the ability to solve problems, was rated by nine of the eleven teachers in the "experimental" pattern to be as effective as or better than their usual pattern, and was found by nine of eleven teachers in the "experimental" pattern to produce pupil farm plans as good as or better than those usually written, leaders in the field of agricultural education should continue to advocate the use of the "experimental" pattern of teaching.

The methods and resources used by vocational agriculture teachers in teaching farm management to high school students was the subject of an investigation by Borkovec (6). A questionnaire was sent to a random sample of 53 teachers of vocational agriculture who had taught for two or more years and to three farm management specialists at the University of Wisconsin. The most common method used by both teachers and specialists was lecturing. Vocational agriculture teachers used more reports, field trips, resource people, visual aids, and the shop than did the farm management specialists. Farm management specialists reported a greater use of the laboratory farm and workbook. The author stated that the biggest problem in teaching farm management was that of motivation and keeping the students interested. More time was needed for field trips was reported by 19 percent of those questioned.

The relationship of class size and department enrollment to the

achievement of students in high school vocational agriculture in Iowa was studied by Tindall (34) as a part of a larger project entitled "An Experimental Evaluation of the Effectiveness of Selected Techniques and Resources on Instruction in Vocational Agriculture." This study was a companion study to the one conducted by the author.

A random sample of 42 Iowa high school vocational agriculture departments was selected from those departments that met certain criteria. Six schools were then randomly assigned to one of the seven instructional media treatments. The instructional media treatments included audio-tutorial, demonstration, field trip, prepared lesson plan, single-concept film, transparency, and video-tape media. Instructional materials were developed cooperatively by members of the project staff in each of the four subject matter areas: animal health, commercial fertilizers, small gasoline engines, and farm credit. These four subject matter areas were studied at the ninth, tenth, eleventh, and twelfth grade levels respectively.

A pre-test was administered prior to the beginning of the three week unit of instruction and a post-test was given at the end of the instruction. Additional information was obtained from the students prior to the experiment in the form of standardized tests and student and teacher questionnaires.

Tindall (34) divided the classes into two groups, a small class division of 5 to 14 students per class and a large class division of 15 to 25 students per class. The vocational agriculture departments were also divided into two groups. The small departments had a total enrollment of 36 to 52 students and the large departments had 54 to 79 students.

The mean gain between pre-test and post-test scores of students in

small departments was higher than that of students in the large departments when field trips were used. This study also indicated that students in the small classes achieved higher than those in the large classes when field trips were used.

A companion study, by Beane (3) was conducted to determine the relationship between instructors' knowledge of subject matter and their students' level of academic achievement. The procedure was similar to that used by Tindall (34) with the addition of a pre-test and post-test administered to the teachers in each of the four subject matter areas to be taught. Six schools were also added as a control. The instructors were then placed in three equal-sized groups, high, medium, and low, on the basis of the differences between the pre-test and post-test scores. The results of the study indicated that (1) students whose instructors were in the medium group had the highest level of achievement and students whose instructors were in the low group had the lowest level of achievement, (2) instructors' knowledge of the subject matter increased as they taught the unit, (3) student achievement was not related to instructors' change in knowledge as they taught the units, and (4) instructors' knowledge and change in knowledge did not interact with the instructional media used.

Klit (26) experimentally evaluated the effectiveness of single-concept films in another companion study. He compared the achievement of students in the six schools using single-concept films to that of the students in six control schools. The results of the study were summarized by Klit (26, p. 86) as follows:

1. The students in the treatment and control schools were quite similar in prior knowledge of the subject matter before the experiment began.

2. In all but the animal health unit, statistical analyses did not reveal any difference in magnitude of change in knowledge from the pre-test to the post-test. In the animal health unit, the control schools had a greater magnitude of change.
3. The specific objective test results were basically no different than the overall subject matter test.
4. All analyses comparing the achievement of the vocational agriculture classes taught with the aid of single-concept films to those taught in a traditional manner found no difference in achievement of the two groups as measured by the post-test scores.
5. The students who performed best when taught with single-concept films seemed to be those with the highest pre-test, intelligence quotient, Differential Aptitude Test (Verbal section), and the agricultural achievement test scores. This was not found to be much different than the characteristics of the students performing best in the control schools.
6. The variable used in predicting post-test scores accounted for a large amount of variation existing in the scores as measured by the multiple R^2 values.
7. The amount of variation in post-test scores of students in the treatment schools that was accounted for by dummy variables representing school was found to be significant for the animal health, commercial fertilizer, and small gasoline engines units. The variation in student post-test scores did not seem to be influenced by school differences in the farm credit unit. The results were reversed for the control schools. The first three units showed no school effect, whereas the farm credit unit did.

The effectiveness of overhead projected transparencies on instruction in vocational agriculture was the subject of a study by Bendixen (4). This study was also a part of the larger study entitled "An Experimental Evaluation of the Effectiveness of Selected Techniques and Resources on Instruction in Vocational Agriculture." He compared the achievement of students in the six schools using transparencies to that of students in the six control schools. Results of this study indicated there were no significant differences between the post-test scores of the treatment and the control groups in any of the four subject matter areas. Bendixen (4) also tested the effects of various types of transparencies on student achievement. Students who observed colored background and mixed variety transparencies

scored higher than did those who observed black and white transparencies. However, the differences were not statistically significant. The most reliable predictors of the students' academic achievement on post-test scores in the four subject matter areas in this study were the Nebraska Agricultural Achievement Test, Differential Aptitude Test (Verbal) and the Otis Quick Scoring Mental Ability Test.

Studies in Related Areas

The purpose of a study by Kinning (25) was to compare the effectiveness of a 16 mm. motion picture and an industrial trip on learning in industrial arts. Kinning studied a group of 141 boys enrolled in a woodshop course in Johnson High School, St. Paul, Minnesota, during the 1964-1965 school year. He ranked the students into three equal groups of high, average, and low on the basis of their Otis Gamma Intelligence Test Scores. Random assignment was then made to Group A, which toured an industrial plant; Group B, who viewed films on approximately the same material as the field trip covered; and Group C, a control. Kinning administered a test of knowledge related to the treatment and the same test was administered seven weeks later for a retention measurement. The data were analyzed using a treatment by levels analysis of variance. Kinning found that the film treatment was superior to the tour treatment and an interaction occurred between treatment groups and ability groupings on the first measurement but not on the retention measure.

Hug (20) investigated the major school, environmental, and teacher-related factors that influence upper elementary teachers in the utilization of outdoor instructional activities. A personal interview was conducted

with fourth, fifth, and sixth grade teachers in a six county area of north-central Illinois. The study included 30 teachers who had carried on outdoor instructional activities with their classes during the 1961-1962 school year and 30 randomly selected teachers who had not carried on outdoor instructional activities. The data were analyzed using the Kolmogorov-Smirnov one-sample test to test for significant differences between the ratings of the two groups of teachers and the Pearson product-moment coefficient of correlation was used to determine relationships between the various factors. The author concluded that upper elementary teachers used outdoor instructional activities to a larger extent when they had (1) experience in camp leadership positions, (2) more education, (3) majored in education, (4) their education more recently, (5) taken many outdoor related courses, (6) small classes, (7) sufficient reference materials, (8) adequate teaching aids and equipment, (9) numerous outside resource people to help the classroom teacher, (10) satisfactory results of previous outdoor instructional activities, (11) an understanding of the values of outdoor instructional activities in their teaching, (12) personal interest in the out-of-doors, (13) interest in trying new things, and (14) participated in many outdoor related leisure time activities. The factors that discouraged the use of outdoor instructional activities by upper elementary teachers included: (1) the notion that textbook or basic materials must be covered and (2) a lack of curricular materials about outdoor instructional activities.

An experimental study of the effects of field trips upon the development of scientific attitudes in a ninth grade general science class was conducted by Harvey (19). This study was undertaken in the spring of 1949

with two sections of general science, with 34 students in each class who had been matched on intelligence and scientific attitudes. Selection of the control and experimental groups were made at random. The unit studied was on conservation and included two field trips. The experimental group experienced the field trips prior to the final test, whereas the control group experienced the field trips after the final test. A highly significant gain was found on the final scores on scientific attitudes in favor of the experimental group that had experienced the field trips.

The effectiveness of the teachers introduction in implementing a science field trip was the subject of an investigation by Delaney (15). Subjects used in this study were seventh grade science and social studies students at the New Hyde Park School, New York. The experimental and control groups were composed of students who were matched on the basis of intelligence and reading scores. The treatment and control groups were then divided into three groups, advanced, regular, and modified. The treatment group was skillfully introduced to the field trip, whereas, only the most necessary and cursory remarks were made to the control. The results of this investigation revealed that those students in the regular and modified groups were shown to have benefited significantly from the introduction of the field trip. Those students in the advanced group did not significantly benefit from the introduction of the field trip.

Benz (5) compared the efficiency of field trips to that of slides taken of the same region in the teaching of earth science. The subjects for this investigation were four ninth grade general science classes of Central High School, St. Paul, Minnesota. The students were randomly assigned to either a field trip or slides section. The field trip section

consisted of two groups with a total enrollment of 39 boys and 16 girls, whereas, 42 boys and 12 girls were in the two groups in the slide section. A significant gain in the knowledge of earth science was obtained in three of the four classes under experimentation. The field trip section indicated a higher achievement than did the slides section, however, this was not shown to be statistically significant.

An investigation by Price (32) presented data from questionnaires received from the principals of 268 elementary schools scattered throughout 45 states and the District of Columbia concerning the number and type of field trips used. The rank of frequency of types for 122 of these schools, each of which included the entire eight grades, was (1) museums, (2) civic buildings, (3) libraries, (4) urban industries, (5) higher schools, (6) rural industries, (7) newspapers, (8) banks, and (9) commercial offices. When principals were asked to indicate whether or not these field trips were of high, medium, or no value, more than 75 percent rated these activities as of high value. No principal rated field trips as of low or no value.

The purpose of a study by Curtis (12) was to measure the contribution of an excursion procedure, when used as a summary device, to the understanding of content material taught in the classroom by a highly illustrative method. The 32 children in the fifth grade at University Elementary School, State University of Iowa, Iowa City, Iowa, comprised the population. These students were then randomly assigned to one of the two groups, a pre-excursion group and a post-excursion group. The pre-excursion group was tested before the excursions and the post-excursion group was tested after the excursion. The unit studied was on erosion and conservation of

soil. Curtis (12) concluded (1) excursions contributed to understanding when used as a summary technique, (2) too much should not be expected of the excursion, and (3) the excursion should be used when illustrations are available in the community or the children have limited experiences in the area being studied.

Clark (11) attempted to identify some of the contributions that the excursion yielded in four sixth grade units: Egypt, printing, transportation, and communications. Nine Minneapolis teachers were selected to participate in this experiment. In order to reduce any teacher bias toward the experiment the schools were rotated so that each school which served as a control group on one unit became an experimental group on the next unit. A total of 163 boys and 172 girls were distributed throughout the nine experimental groups. Statistically significant mean test scores were found for the control group in the Egyptian unit, experimental group in the printing unit, boys in the experimental group in the transportation unit, and the experimental group in the communications unit. Children in the experimental group recorded a greater variety of items which were of interest to them and in which they would like to engage after the unit was finished.

The effect of excursions on an experimental group of 26 high school pupils in ancient history classes was the subject of a study by Atyeo (1). A control group, matched on the basis of age, intelligence quotient, and performance on standardized history tests was taught with the same methods excluding only visits to various museums. Atyeo concluded that the excursion technique is superior to class discussion for teaching materials requiring comparisons and knowledge of concrete objects which can be more easily visualized with the aid of experiences which the excursion offered

and that class discussion yields better results for material in which memory is important such as dates, dimensions, and items usually presented in list or outline form in notebook or textbook. Atyeo (1) also studied the relative effects of field trips and regular class procedure upon later interests. The experimental group showed an increased desire to visit the countries studied and to visit places in the vicinity which held some relationship to the subject matter covered; the discussion group expressed a stronger desire to read books relating to the material than in making excursions.

This review of literature supported the view that field trips are important in the learning process. However, little experimental research has been conducted on the effectiveness of field trips as an instructional technique.

METHOD OF PROCEDURE

The purpose of this study was to determine the effectiveness of field trips in the teaching of selected units of instruction in vocational agriculture. An additional aspect of this study was to determine the effect of field trips on student achievement when certain school, teacher, home, and student characteristics were controlled.

This study was conducted as a part of a larger project entitled, "An Experimental Evaluation of the Effectiveness of Selected Techniques and Resources on Instruction in Vocational Agriculture." In this study, seven treatment groups and a control were compared in the teaching of selected units of instruction in vocational agriculture. The methods of instruction included: (1) audio-tutorial, (2) demonstrations, (3) field trips, (4) overhead transparencies, (5) prepared lesson plans, (6) single-concept films, (7) video-tape, and (8) control.

Design of the Study

Certain information was obtained by questionnaire from a list of Iowa high schools offering vocational agriculture during the 1968-1969 school year to determine the eligibility of the schools to participate in the study. In order to be included in the population for the study, a school had to meet the following criteria:

1. The teacher must have had at least one year of teaching experience.
2. Separate classes must be held for each of the four grade levels.
3. At least seven and no more than 22 students must be enrolled in each class.

4. A minimum of 35 students must be enrolled in the vocational agriculture department.

From the list of schools that met the criteria, six schools were randomly assigned to each of seven treatment groups and a control group. The list of field trip and control schools, names of instructors, and enrollments, which are the subjects of interest in this investigation, are presented in Table 2. The geographic locations of the selected schools are shown in Figure 1.

The experimental design used in this study was the pre-test versus post-test control group design. In their discussion of tests of significance for this design, Campbell and Stanley (8, p. 23) state:

> ... Where intact classes have been assigned to treatments ... the randomization procedure obviously has been more "lumpy" and fewer chance events have been employed. ... Essentially, the class means are used as the basic observations, and treatment effects are tested against variations in these means.

Development of Materials

The project staff selected a unit of instruction for each of the four grade levels (ninth, tenth, eleventh, and twelfth) in vocational agriculture. The units selected for each grade were representative of the instruction received at that particular level. Following is a description of the four units selected:

1. Animal health - the identification, causes, prevention, and control of the major swine, sheep, and cattle parasites and diseases. This unit of instruction was developed for students in the ninth grade.
2. Commercial fertilizers - the study of the essential plant food

Table 2. Number of students by technique, school, instructor, and subject matter area

Technique	School	Instructor	Subject matter area				Total
			Animal health	Commercial fertilizers	Small gasoline engines	Farm credit	
Field trip	Albert City	Allen Henigan	18	13	15	9	55
	Buffalo Center	Wayne Nattress	8	15	9	10	42
	Calmar	Wallace Reidel	20	16	17	11	64
	Eddyville	Donald Kent	15	12	13	9	49
	LaPorte City	Ronald Borton	7	16	22	9	54
	Southeast Warren	Paul Blount	9	14	13	10	46
	Total		77	86	89	58	310
Control	Alta	Harold Carstens	12	7	8	8	35
	Everly	Dale Fisher	7	9	9	11	36
	Hartley	Harold Woodard	12	8	10	9	39
	Rock Valley	Donald Kaberna	10	9	8	10	37
	Sac City	Larry Redding	10	8	14	8	40
	West Liberty	Richard Wehde	16	10	10	9	45
	Total		67	51	59	55	232
Grand total			144	137	148	113	542

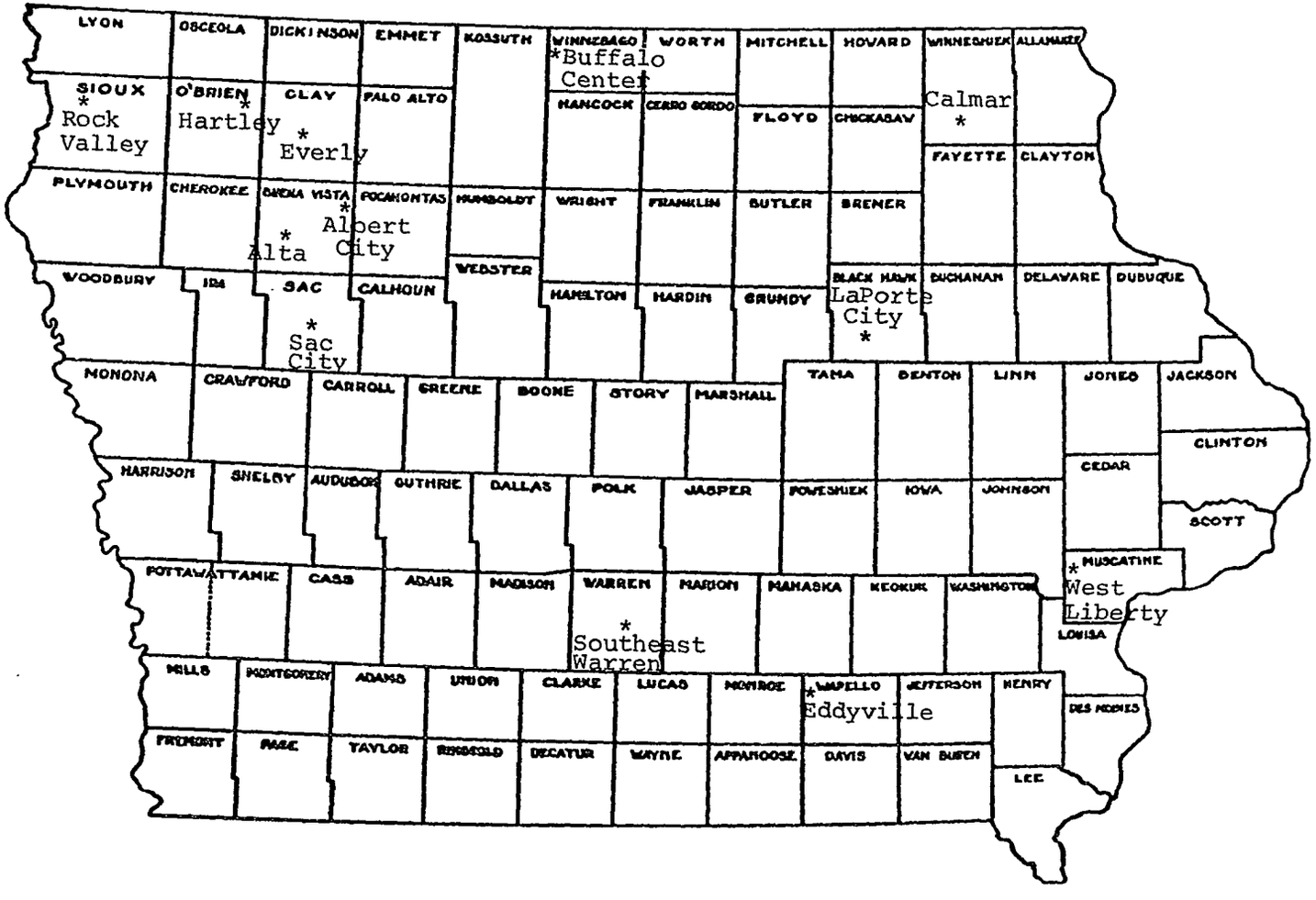

Figure 1. Geographical location of participating schools

elements, crop hunger signs, soil sampling, liming, fertilizer application rates, and selection of fertilizers. This unit of instruction was developed for students in the tenth grade.

3. Small gasoline engines - the principles of operation of the two- and four-stroke engines, functions of the engine parts, measuring devices, and preventive maintenance in small gasoline engines. This unit of instruction was developed for students in the eleventh grade.
4. Farm credit - budgeting principles, types of loans, sources of credit, interest rates, collateral, credit instruments, and the use of farm credit. This unit of instruction was developed for students in the twelfth grade.

A three-week teaching outline (Appendix A) was developed which included the overall objectives, specific day-by-day objectives, and reading assignments for each of the four units. All twelve schools that participated in the experiment were provided with the same reference material and varied their instruction only in the use of field trips by the six treatment schools.

The field trip schools could not use any of the other media that were tested in the larger study. The control schools were not allowed to use field trips or any of the other six techniques that were tested in the larger study. Both the field trip and the control schools were allowed to use any other techniques that they wished.

A total of four field trips were planned for each of the units of instruction being taught. They consisted of planned visits to points outside of the classroom or shop that could be completed in a regular 55-minute

class period. These field trips were to farms and agricultural businesses available in the community. Each of the field trips was developed around the following five steps:

1. teacher preparation,
2. student preparation on the day prior to the field trip,
3. student preparation on the day of the field trip,
4. field trip,
5. field trip follow-up.

A worksheet was developed for the student to complete on the field trip. The teachers were also encouraged to have their own students develop questions to be answered while on the field trip. The list of field trips taken in each of the units and the worksheets that were developed are presented in Appendix B.

Each of the six treatment schools were provided with directions for the teachers to follow in completing the field trip and enough copies of the worksheets for each of their students. The control schools were not provided with the directions for taking the field trips or the student worksheets.

A 60-item test was developed by project staff members who were not associated with the development of the seven instructional techniques being tested. This was used as both the pre-test and post-test. An item analysis of the post-test revealed the following coefficients of reliability:

1. animal health - .85,
2. commercial fertilizers - .85,
3. small gasoline engines - .85, and
4. farm credit - .87.

Training of Teachers

The instructors who participated in the experiment were given one-half day briefings at three different locations throughout the state to familiarize them with the experiment. The instructors were then brought to Iowa State University at a later date for a one and one-half day training session on the correct use of the instructional technique they were to use.

The field trip instructors were briefed on the role of the field trip in instructional programs and were taken on a field trip to illustrate its proper use. They also discussed the various field trips and became acquainted with the material that was to be covered in each. Some time was also spent in acquainting the teachers with the reference material to be used. Each teacher was informed that they were not to use any of the other six techniques tested in the larger experiment, but they could use any other instructional techniques.

Teachers in the control group were also acquainted with the reference material that would be used. Emphasis was placed on the fact that they could not use any of the seven techniques tested in the larger experiment, but they could use any other instructional techniques.

Collection of Data

Information concerning each of the students was collected over a two month period prior to the beginning of the experiment. The information was obtained by having the school counselor in each of the schools administer the following tests:

1. Otis Quick-Scoring Mental Ability,
2. Kuder General Interest Survey (Form E),

3. Nebraska Agriculture Achievement,
4. Differential Aptitude Test - Mechanical Section,
5. Differential Aptitude Test - Abstract Section, and
6. Differential Aptitude Test - Verbal Section.

Data on the students socio-economic backgrounds were collected by questionnaire. In addition, each of the students was asked to indicate which of a selected list of activities they had performed in the appropriate subject matter area.

Measures taken on the teacher included the Minnesota Teacher Attitude Inventory and a pre-test and post-test on teacher knowledge in each of the four subject matter areas. An item analysis of the instructor post-test scores by Beane (3) revealed the following coefficients of reliability:

1. animal health - .80,
2. commercial fertilizers - .87,
3. small gasoline engines - .85, and
4. farm credit - .84.

Additional information collected on the teacher included total years of teaching experience, years of tenure at present school, and educational level.

The 60-item test that was used for the pre-test and post-test was administered by the school counselor. The pre-test was given the day prior to the start of the experiment and the post-test was administered on the last day of the experiment.

Analyses of Data

The data gathered from the schools were coded and placed on IBM cards. The class means were then computed for each of the variables and this information was coded and placed on data processing cards for analyses. Since the schools were randomly selected, the class means were the observations which were used in analyzing the data. Analyses were conducted at the Iowa State University Computation Center. Statistical methods used in analyzing the data included analysis of variance, analysis of covariance, a two-factor experiment with repeated measures, and step-wise regression.

The analysis of variance model used in this study was as follows:

$$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$$

where

Y = class pre-test means per treatment, per school,

μ = overall grand mean of the pre-tests,

α = contribution of treatment effect (field trip vs. control),

ε = random error associated with the class pre-test means,

$i = 1, 2$, and

$j = 1, 2, \ldots, 6$.

The model used in the analysis of covariance was as follows:

$$Y_{ij} = \mu + \alpha_i + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k + \varepsilon_{ij}$$

where

Y = class post-test mean per treatment, per school,

μ = overall grand mean of the post-tests,

α = contribution of treatment effect (field trip vs. control),

$\beta_1, \beta_2, \ldots, \beta_k$ = regression coefficient,

$x_1, x_2, \ldots, x_k$ = the deviation of any X covariate from the X covariate mean,

ε = random error associated with the class post-test means,

i = 1, 2,

j = 1, 2, ..., 6, and

k = 1, 2, 3, 4.

A two-factor experiment with repeated measures as presented by Winer (36) was completed as a part of the analyses. The model for this analysis was as follows:

$$Y_{ijk} = \mu + \alpha_i + \varepsilon_{ij} + \beta_k + (\alpha\beta)_{ik} + \delta_{ijk}$$

where

Y = class pre-test and post-test means per treatment, per school, per repeated measure,

μ = overall grand mean of the pre-test and post-test means,

α = contribution of treatment effect (field trip vs. control),

ε = error associated with the treatment effect (field trip vs. control),

β = effect of the repeated measure (pre-test and post-test),

$(\alpha\beta)$ = interaction of the treatment (field trip vs. control) and the repeated measure (pre-test and post-test),

δ = random error associated with the class pre-test and post-test means,

i = 1, 2,

j = 1, 2, ..., 6, and

k = 1, 2.

A step-wise regression analysis was conducted to identify the variables that could be used to account for the variation in the mean post-test

scores. The model used in this analysis was as follows:

$$Y_{ij} = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon_{ij}$$

where

Y = class post-test mean per treatment, per school,

β_o = Y intercept or height of regression line at origin,

$\beta_1, \beta_2, \ldots, \beta_k$ = regression coefficients,

$X_1, X_2, \ldots, X_k$ = independent variables used to predict post-test class means,

ε = random error associated with the class post-test means,

$i = 1, 2,$

$j = 1, 2, \ldots, 6,$ and

$k = 1, 2, \ldots, 10.$

FINDINGS

The findings of this study were subdivided into the following four major categories:

1. animal health,
2. commercial fertilizers,
3. small gasoline engines, and
4. farm credit.

The findings presented give evidence to support the acceptance or rejection of the null hypotheses. The hypotheses were stated in accordance with the objectives of the study as presented in the Introduction.

The analyses conducted in this study used class means as the basic observation since the schools were randomly selected. The treatment effects were then tested against variations in the class means. The statistical models used in analyzing the data can be found in the Method of Procedure.

Animal Health

The means for the dependent variable (post-test) and for each of the 28 independent variables associated with instruction in animal health in the field trip and control schools are presented in Table 3. This table also presents the overall mean score for each of the variables. These means provided the information concerning the treatment effects which were then tested against the variations in the class means.

Ho_1: There were no differences between the mean pre-test scores of the field trip and control schools for the animal health unit.

Data from Table 3 revealed that the field trip schools had a mean pre-

Table 3. Means for dependent and independent variables for the animal health unit by instructional technique

Variable	Technique		Overall mean
	Field trip	Control	
Pre-test	35.38	34.04	34.71
Post-test	52.94	57.57	55.26
Intelligence quotient	101.35	101.96	101.66
Mechanical aptitude	55.70	58.64	57.17
Abstract aptitude	56.29	59.72	58.01
Verbal aptitude	55.23	56.38	55.81
Agricultural achievement	59.57	57.41	58.49
Outdoor interest	75.31	70.53	72.92
Mechanical interest	51.58	52.08	51.83
Computational interest	45.72	52.03	48.87
Scientific interest	34.43	34.98	34.70
Persuasive interest	52.14	57.45	54.79
Artistic interest	47.34	40.13	43.74
Literary interest	53.39	46.54	49.97
Social service interest	46.58	38.64	42.61
Clerical interest	56.51	47.92	52.22
Student skill sheet	45.26	45.67	45.47
Crop acres	200.86	228.21	214.54
Non-crop acres	71.63	32.33	51.98
Total farm acres	275.70	260.55	268.13
Animal units	77.94	123.99	100.97
Number of brothers and sisters	3.71	3.22	3.46
Semesters of vocational agriculture	1.90	1.98	1.94
Semesters of science	1.94	1.88	1.91
Teacher knowledge	30.33	33.67	32.00
Teacher personality	59.33	52.67	56.00
Class size	13.00	11.50	12.25
Department size	51.67	39.17	45.42
Teacher tenure	6.17	4.83	5.50
Teacher experience	8.00	6.83	7.42

test score of 35.38, whereas, the control schools had a mean pre-test score of 34.04. A single classification analysis of variance was calculated for the mean pre-test scores to see if these scores differed significantly and is shown in Table 4. The F-value obtained (.20) revealed that the mean

Table 4. Analysis of variance on mean pre-test scores for the animal health unit

Source of variation	d.f.	S.S.	M.S.	F
Technique	1	5.39	5.39	.20
Error	10	263.00	26.30	
Total	11	268.39		

pre-test scores were not significantly different and the null hypothesis was not rejected. There were no differences between the mean pre-test scores of the field trip and control schools for the animal health unit.

Ho_2: There were no differences between the combined mean pre- and post-test scores of the field trip and control schools for the animal health unit.

Ho_3: There were no differences between the mean pre- and post-test scores of the field trip and control schools for the animal health unit.

Ho_4: There were no differences between the magnitude of change from the mean pre- to post-test scores of the field trip and control schools for the animal health unit.

A two-factor experiment using repeated measures was used to test the preceding three hypotheses. In this type of analysis, Winer (36) indicated that two separate error terms should be used in testing the hypotheses. In Ho_2 the effects tested would be confounded with the differences between the pre- and post-test means. The appropriate error term for this hypothesis

is large and reduces the chance of significance. A different error term is used in testing Ho_3 and Ho_4 which is not affected by confounding and results in a more sensitive test.

Analysis for the two-factor experiment using the repeated measures of mean pre- and post-test scores in the animal health unit is presented in Table 5. The nonsignificant F-value (.14) supports the hypothesis that there were no differences between the combined mean pre- and post-test scores of the field trip and control schools for the animal health unit and the hypothesis was not rejected. However, it should be kept in mind that this effect is confounded with the differences between the pre- and post-test means. The second hypothesis (Ho_3) was rejected when a highly significant F-value (76.95) was obtained. The mean pre- and post-test scores of the field trip and control schools were different indicating that a signif-

Table 5. Analysis of a two-factor experiment using the repeated measures of class mean pre- and post-test scores for the animal health unit

Source of variation	d.f.	S.S.	M.S.	F
Technique	1	16.30	16.30	.14
Error (a)	10	1185.80	118.58	
Time	1	2532.57	2532.57	76.95**
Technique x time	1	53.58	53.58	1.63
Error (b)	10	329.10	32.91	
Total	23	4117.35		

**Significant beyond the one percent level.

icant gain in knowledge occurred between the time of the pre- and post-tests. The analysis of variance test for the third hypothesis (Ho_4) provided a nonsignificant F-value (1.63) and the hypothesis was not rejected. There were no differences between the magnitude of change from the mean pre- to post-test scores of the field trip and control schools for the animal health unit.

A stepwise regression using class means for each of the independent variables for the animal health unit was calculated and the results are presented in Table 6. Data presented include the step in which a variable entered the regression, the variable that entered, R^2, and the F to remove the variable from the equation. In their discussion of regression, Draper

Table 6. Stepwise regression using class means for each of the independent variables for the animal health unit

Step	Variable	R^2	F to remove
1	Crop acres	.66	19.09
2	Mechanical aptitude	.90	33.58
3	Semesters of vocational agriculture	.94	6.19
4	Scientific interest	.97	5.06
5	Teacher knowledge	.99	14.03
6	Teacher experience	.99	8.60
7	Social service interest	.99	4.41
8	Persuasive interest	.99	5.03
9	Non-crop acres	.99	20.61
10	Total farm acres	1.00	842920.00

and Smith (17, p. 63) stated:

> ... R^2 is a measure of the usefulness of the terms, other than B_o in the model. It is important to realize that R^2 can be made unity simply by employing n properly selected coefficients in the model, including B_o, since a model can then be chosen which fits the data exactly.
>
> ... Since R^2 is often used as a convenient measure of the success of the regression equation in explaining the variation in the data, we must be sure that an improvement in R^2 due to adding a new term to the model has some real significance and is not due to the fact that the number of parameters in the model is getting close to the saturation point--that is, the number of observations.

In the analysis presented, 12 observations were used and the saturation point was reached with the tenth step in the animal health unit causing the R^2 to reach 1.00. However, the first three variables (crop acres, mechanical aptitude, and semesters of vocational agriculture) accounted for 94 percent of the variation in the data.

Ho_5: There were no differences between the mean scores for the animal health post-test in the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates.

The mean pre-test, intelligence, and agricultural achievement scores for the field trip and control schools are presented in Table 3. The adjusted and unadjusted means for these same schools are presented in Table 7. An initial difference in post-test scores of 4.63 points was noted between the field trip and control schools. A difference of 6.83 points was obtained when the post-test scores were adjusted with respect to pre-test, intelligence, and agricultural achievement scores. An analysis of covariance was computed on these post-test scores and is reported in Table 8. A nonsignificant F-value of 2.59 was obtained and the null hypothesis was not

Table 7. Unadjusted and adjusted means for animal health post-test when pre-test, intelligence, and agricultural achievement scores were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	52.94	51.84
Control	57.57	58.67
Difference	4.63	6.83

rejected. There were no differences between the mean scores for the animal health post-test in the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates.

Ho_6: There were no differences between the mean scores for the animal health post-test in the field trip and control schools when scientific, persuasive, and social service interest scores were used as covariates.

Table 8. Analysis of covariance for the animal health post-test scores for the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates

Source of variation	Residuals			
	d.f.	S.S.	M.S.	F
Technique	1	127.18	127.18	2.59
Error	7	343.21	49.03	
Total	8	470.39		

The interest factors used as covariates in this hypothesis were identified by the stepwise regression reported in Table 6. The means for the scientific, persuasive, and social service interests for the two techniques being tested are reported in Table 3. The field trip and control schools unadjusted and adjusted post-test means for the animal health unit are presented in Table 9. The difference between the field trip and control

Table 9. Unadjusted and adjusted means for animal health post-test when scientific, persuasive, and social service interest scores were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	52.94	51.10
Control	57.57	59.41
Difference	4.63	8.31

schools increased from 4.63 to 8.31 points in favor of the control schools when the post-test scores were adjusted using scientific, persuasive, and social service interest scores. The null hypothesis was not rejected. A nonsignificant F-value (1.32) was obtained on the analysis of covariance reported in Table 10. There were no differences between the mean scores for the animal health post-test in the field trip and control schools when scientific, persuasive, and social service interest scores were used as covariates.

Ho_7: There were no differences between the mean scores for the animal health post-test in the field trip and control

Table 10. Analysis of covariance for the animal health post-test scores for the field trip and control schools when scientific, persuasive, and social service interest scores were used as covariates

Source of variation	Residuals d.f.	S.S.	M.S.	F
Technique	1	143.83	143.83	1.32
Error	7	760.06	108.58	
Total	8	903.89		

schools when mechanical, abstract, and verbal aptitude were used as covariates.

The mechanical, abstract, and verbal aptitude means are reported in Table 3. Data in Table 11 present the unadjusted and adjusted animal health post-test means when mechanical, abstract, and verbal aptitude scores were used as covariates. The differences between the post-test mean scores for the field trip and control schools decreased from 4.63 to 1.75

Table 11. Unadjusted and adjusted means for animal health post-test when mechanical, abstract, and verbal aptitudes were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	52.94	54.38
Control	57.57	56.13
Difference	4.63	1.75

points. The animal health post-test scores were then analyzed using the analysis of covariance and is reported in Table 12. A nonsignificant F-value (.26) was obtained and the null hypothesis was not rejected. There were no differences between the mean scores for the animal health post-test in the field trip and control schools when mechanical, abstract, and verbal aptitudes were controlled.

Table 12. Analysis of covariance for the animal health post-test scores for the field trip and control schools when mechanical, abstract, and verbal aptitudes were used as covariates

Source of variation	Residuals d.f.	S.S.	M.S.	F
Technique	1	23.19	23.19	.26
Error	7	620.20	88.60	
Total	8	643.39		

Ho_8: There were no differences between the mean scores for the animal health post-test in the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates.

Data in Table 3 present the mean number of crop acres, non-crop acres, and animal units for the field trip and control schools. The unadjusted and adjusted means for field trip and control schools are reported in Table 13. When the post-test means were adjusted, it was revealed that achievement in the field trip schools exceeded that of the control schools by 2.31 points.

Table 13. Unadjusted and adjusted means for animal health post-test when crop acres, non-crop acres, and animal units were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	52.94	56.41
Control	57.57	54.10
Difference	4.63	2.31

An analysis of covariance was calculated and is reported in Table 14. The F-value (.25) was nonsignificant and the null hypothesis was not rejected. There were no differences between the mean scores for the animal health post-test in the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates.

Ho_9: There were no differences between the mean scores for the animal health post-test in the field trip and control schools when teacher knowledge, personality, tenure, and

Table 14. Analysis of covariance for the animal health post-test scores for the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	13.66	13.66	.25
Error	7	379.05	54.15	
Total	8	392.71		

experience were used as covariates.

The means for the teacher variables that were used as covariates in this hypothesis are presented in Table 3. Unadjusted and adjusted means are indicated in Table 15 for the animal health post-test scores. Examination of the adjusted mean post-test scores revealed that achievement in the field trip schools exceeded that in the control schools by 7.05 points when teacher knowledge, personality, tenure, and experience were used as covariates.

Table 15. Unadjusted and adjusted means for animal health post-test when teacher knowledge, personality, tenure, and experience were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	52.94	58.78
Control	57.57	51.73
Difference	4.63	7.05

An analysis of covariance was calculated to determine if there were differences between the adjusted means and is reported in Table 16. The F-value obtained (1.75) was nonsignificant and the null hypothesis was not rejected. There were no differences between the mean scores for the animal health post-test in the field trip and control schools when teacher knowledge, personality, tenure, and experience were used as covariates.

Ho_{10}: There were no differences between the mean scores for the animal health post-test in the field trip and control

Table 16. Analysis of covariance for the animal health post-test scores for the field trip and control schools when teacher knowledge, personality, tenure, and experience were used as covariates

Source of variation	Residuals d.f.	S.S.	M.S.	F
Technique	1	237.12	237.12	1.76
Error	6	815.04	135.84	
Total	7	1052.16		

schools when class and department size were used as covariates.

The mean sizes of classes and departments for the field trip and control schools are reported in Table 3. The unadjusted and adjusted means for the field trip and control schools when class and department size were used as covariates are presented in Table 17.

An analysis of covariance was computed on the means for the pre-test in the animal health unit using class and department size as covariates and

Table 17. Unadjusted and adjusted means for animal health post-test when class and department size were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	52.94	61.91
Control	57.57	48.60
Difference	4.63	13.01

is reported in Table 18. The null hypothesis was not rejected when a non-significant F-value (1.43) was obtained. There were no differences between the mean scores for the animal health post-test in the field trip and control schools when class and department size were used as covariates.

Table 18. Analysis of covariance for the animal health post-test scores for the field trip and control schools when class and department size were used as covariates

	Residuals			
Source of variation	d.f.	S.S.	M.S.	F
Technique	1	134.87	134.87	1.43
Error	8	752.80	94.10	
Total	9	887.67		

Ho_{11}: There were no differences between the mean scores for the animal health post-test in the field trip and control schools when agricultural achievement, animal units, department size, and teacher tenure were used as covariates.

The four covariates used in this analysis were selected to control for initial differences in the student, home, school, and teacher. Means for these four covariates are reported in Table 3. Data in Table 19 indicate the unadjusted and adjusted mean post-test scores for the animal health unit in the field trip and control schools. An initial difference of 4.63 points was noticed in the mean post-test scores. After adjusting the means, the difference was decreased to 1.69 points in favor of the control schools.

Table 19. Unadjusted and adjusted means for animal health post-test when agricultural achievement, animal units, department size, and teacher tenure were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	52.94	54.41
Control	57.57	56.10
Difference	4.63	1.69

An analysis of covariance was calculated on the post-test means for the animal health unit using agricultural achievement, animal units, department size, and teacher tenure as covariates and is reported in Table 20. A nonsignificant F-value (.40) was obtained and the null hypothesis was not rejected. There were no differences between the mean scores for animal health post-test in the field trip and control schools when agricul-

Table 20. Analysis of covariance for the animal health post-test scores for the field trip and control schools when agricultural achievement, animal units, department size, and teacher tenure were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	20.66	20.66	.40
Error	6	312.84	52.14	
Total	7	333.50		

tural achievement, animal units, department size, and teacher tenure were used as covariates.

Commercial Fertilizers

In the commercial fertilizers unit, the field trip and control school means for the dependent variable (post-test) and for the independent variables are reported in Table 21. This table also provides the overall mean scores for these same variables. As was mentioned earlier, the analyses reported in this study tested the treatment effects against variations in class means, which were the basic observations.

Ho_{12}: There were no differences between the mean pre-test scores of the field trip and control schools for the commercial fertilizers unit.

The pre-test means for the commercial fertilizers unit in the field trip and control schools are reported in Table 21. The pre-test scores revealed an initial difference of .19 points in favor of the control schools. An analysis of variance was calculated to determine if there were any significant initial differences between the two treatment groups and is presented in Table 22. A nonsignificant F-value (.00) was obtained and the null hypothesis was not rejected. There were no differences between the mean pre-test scores of the field trip and control schools for the commercial fertilizers unit.

Ho_{13}: There were no differences between the combined mean pre- and post-test scores of the field trip and control schools for the commercial fertilizers unit.

Ho_{14}: There were no differences between the mean pre- and post-

Table 21. Means for dependent and independent variables for the commercial fertilizers unit by instructional technique

Variable	Technique		Overall mean
	Field trip	Control	
Pre-test	33.43	33.62	33.53
Post-test	48.15	48.26	48.21
Intelligence quotient	101.90	104.20	103.05
Mechanical aptitude	54.40	65.84	60.12
Abstract aptitude	54.30	73.44	63.87
Verbal aptitude	53.85	59.15	56.50
Agricultural achievement	59.87	62.14	61.01
Outdoor interest	81.39	74.00	77.70
Mechanical interest	54.59	57.12	55.86
Computational interest	45.77	47.67	46.72
Scientific interest	33.13	37.51	35.32
Persuasive interest	55.99	53.67	54.83
Artistic interest	45.42	48.99	42.21
Literary interest	50.33	48.37	49.35
Social service interest	42.45	40.98	41.71
Clerical interest	60.35	56.01	58.18
Student skill sheet	17.97	13.72	15.85
Crop acres	174.74	236.98	205.86
Non-crop acres	69.20	51.29	60.25
Total farm acres	216.30	289.79	253.05
Animal units	97.02	186.58	141.80
Number of brothers and sisters	4.12	3.62	3.87
Semesters of science	3.39	2.75	3.07
Semesters of vocational agriculture	3.62	3.62	3.62
Teacher knowledge	29.33	33.50	31.42
Teacher personality	59.33	52.67	56.00
Class size	13.67	8.83	11.25
Department size	51.67	39.17	45.42
Teacher tenure	6.17	4.83	5.50
Teacher experience	8.00	6.83	7.42

test scores of the field trip and control schools for the commercial fertilizers unit.

Ho_{15}: There were no differences between the magnitude of change from the mean pre- to post-test scores of the field trip

Table 22. Analysis of variance on mean pre-test scores for the commercial fertilizers unit

Source of variation	d.f.	S.S.	M.S.	F
Technique	1	.10	.10	.00
Error	10	301.90	30.19	
Total	11	302.00		

and control schools for the commercial fertilizers unit.

The three previous hypotheses were tested using a two-factor experiment with repeated measures which is reported in Table 23. Two separate error terms were used in the analysis of variance as suggested by Winer (36) and explained in the animal health section of this chapter. The first of the three null hypotheses (Ho_{13}) was not rejected when a nonsignificant F-value (.00) was obtained. There were no differences between the combined mean pre- and post-test scores of the field trip and control schools for the commercial fertilizers unit. The second hypothesis (Ho_{14}) was rejected when a highly significant F-value (71.55) was obtained. There were differences between the mean pre- and post-test scores of the field trip and control schools. This analysis indicated that there was a significant increase in knowledge between the pre- and post-test. The third null hypothesis (Ho_{15}) was not rejected when a nonsignificant F-value (.00) was obtained. There were no differences between the magnitude of change from the mean pre- to post-test scores of the field trip and control schools for the commercial fertilizers unit.

Table 23. Analysis of a two-factor experiment using the repeated measures of class mean pre- and post-test scores for the commercial fertilizers unit

Source of variation	d.f.	S.S.	M.S.	F
Technique	1	.14	.14	.00
Error (a)	10	1224.30	122.43	
Time	1	1292.86	1292.86	71.55**
Technique x time	1	.01	.01	.00
Error (b)	10	180.70	18.07	
Total	23	2698.01		

**Significant beyond the one percent level.

In Table 24 is a stepwise regression using class means for each of the independent variables for the commercial fertilizers unit. The saturation point, mentioned in the animal health section of this chapter, was reached with the tenth step. The first two variables entered in the stepwise regression (pre-test and social service interest) accounted for 92 percent of the variance in the post-test score. The addition of the variable entered in the third step (agricultural achievement) increased the R^2 to .96. The addition of other variables to the model was of little value because the number of parameters in the model was approaching the saturation point.

Ho_{16}: There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates.

Table 24. Stepwise regression using class means for each of the independent variables for the commercial fertilizers unit

Step	Variable	R^2	F to remove
1	Pre-test	.82	44.81
2	Social service interest	.92	12.87
3	Agricultural achievement	.96	6.58
4	Teacher tenure	.98	7.90
5	Semesters of vocational agriculture	.99	5.78
6	Class size	.99	4.58
7	Total farm acres	.99	44.82
8	Scientific interest	.99	8.62
9	Clerical interest	.99	56.29
10	Computational interest	1.00	8693.00

The mean scores for the pre-test, intelligence, and agricultural achievement variables for the commercial fertilizers unit taught in the field trip and control schools are reported in Table 21. The unadjusted and adjusted means for the commercial fertilizers unit in the field trip and control schools are reported in Table 25. The post-test score for the commercial fertilizers unit in the control schools was .11 points higher than that in the field trip schools. When the post-test scores were adjusted, using pre-test, intelligence, and agricultural achievement scores as covariates, the mean post-test score for the field trip schools exceeded those of control schools by 2.21 points. In Table 26, the analysis of co-

Table 25. Unadjusted and adjusted means for commercial fertilizers post-test when pre-test, intelligence, and agricultural achievement scores were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	48.15	49.31
Control	48.26	47.10
Difference	.11	2.21

variance is presented using the pre-test, intelligence, and agricultural achievement scores as covariates. The null hypothesis was not rejected as a nonsignificant F-value (1.10) was obtained. There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates.

Table 26. Analysis of covariance for the commercial fertilizers post-test scores for the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	12.99	12.99	1.10
Error	7	82.88	11.84	
Total	8	95.87		

Ho_{17}: There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when computational, scientific, persuasive, and clerical interests were used as covariates.

The stepwise regression presented in Table 24 identified the covariates used in this analysis. The mean scores for computational, scientific, persuasive, and clerical interests are presented in Table 21. Unadjusted and adjusted post-test means in the commercial fertilizers unit are reported in Table 27. The mean difference in post-test scores between the

Table 27. Unadjusted and adjusted means for commercial fertilizers post-test when computational, scientific, persuasive, and clerical interest scores were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	48.15	47.94
Control	48.26	48.47
Difference	.11	.53

field trip and control schools increased from .11 to .53 points in favor of the control schools using the four covariates mentioned above (computational, scientific, persuasive, and clerical interest scores). A nonsignificant F-value (.00) was obtained as revealed in Table 28, and the null hypothesis was not rejected. There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when computational, scientific, persuasive, and clerical

Table 28. Analysis of covariance for the commercial fertilizers post-test scores for the field trip and control schools when computational, scientific, persuasive, and clerical interest scores were used as covariates

Source of variation	Residuals d.f.	S.S.	M.S.	F
Technique	1	.28	.28	.00
Error	6	588.30	98.05	
Total	7	588.58		

interest scores were used as covariates.

Ho_{18}: There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when mechanical, abstract, and verbal aptitudes were used as covariates.

Data in Table 21 report the mean scores for the field trip and control schools on the mechanical, abstract, and verbal aptitude variables. The unadjusted and adjusted mean post-test scores for the field trip and control schools are presented in Table 29. It was noted in Table 29 that the achievement of the field trip schools exceeded that of the control schools by 9.93 points when mechanical, abstract, and verbal aptitude were used as covariates. An analysis of covariance was used to analyze these adjusted post-test means and is presented in Table 30. The null hypothesis was not rejected as a nonsignificant F-value (2.76) was obtained. There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when mechanical, abstract, and

Table 29. Unadjusted and adjusted means for commercial fertilizers post-test when mechanical, abstract, and verbal aptitudes were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	48.15	53.17
Control	48.26	43.24
Difference	.11	9.93

Table 30. Analysis of covariance for the commercial fertilizers post-test scores for the field trip and control schools when mechanical, abstract, and verbal aptitudes were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	156.95	156.95	2.76
Error	7	391.72	56.96	
Total	8	548.67		

verbal aptitudes were used as covariates.

Ho_{19}: There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates.

The mean numbers of crop acres, non-crop acres, and animal units are reported in Table 21. The unadjusted and adjusted post-test means for the

commercial fertilizers unit are presented in Table 31. The field trip schools exceeded the control schools by 7.35 points when the post-test scores were adjusted.

Table 32 presents an analysis of covariance using crop acres, non-crop acres, and animal units as covariates. The null hypothesis was not rejected since a nonsignificant F-value (1.13) was obtained. There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when crop acres, non-crop acres,

Table 31. Unadjusted and adjusted means for commercial fertilizers post-test when crop acres, non-crop acres, and animal units were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	48.15	51.88
Control	48.26	44.53
Difference	.11	7.35

Table 32. Analysis of covariance for the commercial fertilizers post-test scores for the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	87.51	87.51	1.13
Error	7	543.90	77.70	
Total	8	631.41		

and animal units were used as covariates.

Ho_{20}: There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when teacher knowledge, personality, tenure, and experience were used as covariates.

The means for each of the teacher variables are presented in Table 21 for the field trip and control schools. In Table 33 are the unadjusted and adjusted mean post-test scores for the commercial fertilizers unit. After the means were adjusted, students in the field trip schools achieved 5.71 points higher than those in the control schools.

Table 33. Unadjusted and adjusted means for commercial fertilizers post-test when teacher knowledge, personality, tenure, and experience were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	48.15	51.06
Control	48.26	45.35
Difference	.11	5.71

The adjusted means were then analyzed by analysis of covariance (Table 34) to determine if the adjusted post-test means were different. A nonsignificant F-value (.12) was obtained and the null hypothesis was not rejected. There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when

Table 34. Analysis of covariance for the commercial fertilizers unit for the field trip and control schools when teacher knowledge, personality, tenure, and experience were used as covariates

Source of variation	Residuals d.f.	S.S.	M.S.	F
Technique	1	18.37	18.37	.12
Error	6	882.18	147.03	
Total	7	900.55		

teacher knowledge, personality, tenure, and experience were used as covariates.

Ho_{21}: There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when class and department size were used as covariates.

Data in Table 21 report the mean class and department size for the field trip and control schools. The unadjusted and adjusted post-test means are reported in Table 35 for the field trip and control schools. Upon inspection of the data, it was noted that the adjusted mean post-test score for the field trip schools was 15.85 points higher than the control schools adjusted mean post-test score.

An analysis of covariance using class and department size as covariates was calculated and is reported in Table 36. A nonsignificant F-value (2.07) was obtained and the null hypothesis was rejected. There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when class and department size

Table 35. Unadjusted and adjusted means for commercial fertilizers post-test when class and department size were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	48.15	56.13
Control	48.26	40.28
Difference	.11	15.85

Table 36. Analysis of covariance for the commercial fertilizers post-test scores when class and department size were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	131.10	131.10	2.07
Error	8	505.92	63.24	
Total	9	637.02		

were used as covariates.

Ho_{22}: There were no differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when abstract aptitude, crop acres, department size, and teacher tenure were used as covariates.

Four variables (abstract aptitude, crop acres, department size, and teacher tenure) were selected to represent the student, home, school, and teacher in this analysis. The means for these independent variables for

the field trip and control schools are reported in Table 21. The unadjusted and adjusted means for the commercial fertilizers post-test are reported in Table 37 for the two types of schools. Post-test achievement in the field trip schools exceeded that in the control schools by 19.83 points when the means were adjusted using abstract aptitude, crop acres, department size, and teacher tenure as covariates.

Table 37. Unadjusted and adjusted means for commercial fertilizers post-test when abstract aptitude, crop acres, department size, and teacher tenure were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	48.15	58.12
Control	48.26	38.29
Difference	.11	19.83

An analysis of covariance on the post-test scores is presented in Table 38. A highly significant F-value (23.35) caused the rejection of the null hypothesis. There were differences between the mean scores for the commercial fertilizers post-test in the field trip and control schools when abstract aptitude, crop acres, department size, and teacher tenure were used as covariates.

Small Gasoline Engines

The basic observations of the effects of field trips were in terms of class means. The treatment effects were obtained from mean scores pre-

Table 38. Analysis of covariance for the commercial fertilizers post-test scores for the field trip and control schools when abstract aptitude, crop acres, department size, and teacher tenure were used as covariates

Source of variation	Residuals d.f.	Residuals S.S.	Residuals M.S.	F
Technique	1	494.78	494.78	23.35**
Error	6	127.14	21.19	
Total	7	621.92		

**Significant beyond the one percent level.

sented for the field trip and control schools in Table 39. The overall mean scores for each of the variables is also presented in Table 39.

Ho_{23}: There were no differences between the mean pre-test scores of the field trip and control schools for the small gasoline engines unit.

The mean pre-test score for the field trip schools exceeded that of the control schools by 1.86 points as revealed by the data presented in Table 39. In order to determine if there were any significant differences at the time of the pre-test, a single classification analysis of variance was calculated and is presented in Table 40. The null hypothesis was not rejected since a nonsignificant F-value (.15) was obtained. There were differences between the mean pre-test scores of the field trip and control schools for the small gasoline engines unit.

Ho_{24}: There were no differences between the combined pre- and post-test scores of the field trip and control schools for

Table 39. Means for dependent and independent variables in the small gasoline engines unit by instructional technique

Variable	Technique		Overall mean
	Field trip	Control	
Pre-test	40.28	38.42	39.35
Post-test	61.47	68.44	64.95
Intelligence quotient	99.09	104.72	101.91
Mechanical aptitude	54.54	51.14	52.84
Abstract aptitude	57.84	60.85	59.35
Verbal aptitude	47.36	52.60	49.98
Agricultural achievement	59.74	61.26	60.50
Outdoor interest	77.88	74.29	76.09
Mechanical interest	59.72	51.58	55.65
Computational interest	50.61	51.64	51.13
Scientific interest	33.96	31.42	32.69
Persuasive interest	55.93	58.75	57.34
Artistic interest	42.65	44.10	43.37
Literary interest	46.03	47.85	46.94
Social service interest	49.20	50.52	49.86
Clerical interest	59.41	56.90	58.15
Student skill sheet	36.73	21.87	29.30
Crop acres	245.37	267.93	256.65
Non-crop acres	60.33	58.63	59.48
Total farm acres	304.91	297.07	300.99
Animal units	114.39	249.93	182.16
Number of brothers and sisters	3.56	2.96	3.26
Semesters of science	3.62	3.57	3.60
Semesters of vocational agriculture	5.42	5.64	5.53
Teacher knowledge	23.00	31.50	27.25
Teacher personality	59.33	52.67	56.00
Class size	14.67	9.67	12.17
Department size	51.67	39.17	45.42
Teacher tenure	6.17	4.83	5.50
Teacher experience	8.00	6.83	7.42

the small gasoline engines unit.

Ho_{25}: There were no differences between the mean pre- and post-test scores of the field trip and control schools for the small gasoline engines unit.

Table 40. Analysis of variance on mean pre-test scores for the small gasoline engines unit

Source of variation	d.f.	S.S	M.S.	F
Technique	1	10.30	10.30	.15
Error	10	705.40	70.54	
Total	11	715.70		

Ho_{26}: There were no differences between the magnitude of change from the mean pre- to post-test scores of the field trip and control schools for the small gasoline engines unit.

These three hypotheses were tested by means of a two-factor experiment using the repeated measures pre- and post-test scores as suggested by Winer (36). Data on the two-factor experiment are presented in Table 41. The first hypothesis (Ho_{24}) was not rejected when a nonsignificant F-value was obtained (.36). There were no differences between the combined pre- and post-test scores of the field trip and control schools for the small gasoline engines unit. However, the effects tested in this hypothesis are confounded with the differences between the mean pre- and post-test scores. The chance for significance with this test was greatly reduced because a large error term was obtained as a result of the confounding.

The second and third hypotheses were not affected by the confounding and the appropriate tests for significance were more sensative. A highly significant F-value (101.73) caused the rejection of the second hypothesis (Ho_{25}). There were differences between the mean pre- and post-test scores

Table 41. Analysis of a two-factor experiment using the repeated measures of class mean pre- and post-test scores for the small gasoline engines unit

Source of variation	d.f.	S.S.	M.S.	F
Technique	1	39.35	39.35	.36
Error (a)	10	1101.20	110.12	
Time	1	3933.42	3933.42	101.73**
Technique x time	1	116.91	116.91	3.02
Error (b)	10	386.60	38.66	
Total	23	5577.48		

**Significant beyond the one percent level.

of the field trip and control schools for the small gasoline engines unit. The third hypothesis (Ho_{26}) was not rejected when a nonsignificant F-value (3.02) was obtained. There were no differences between the magnitude of change from the mean pre- to post-test scores for the field trip and control schools for the small gasoline engines unit.

Data contained in Table 42 present information concerning the stepwise regression using the class means of the independent variables for the small gasoline engines unit. With step 10, the saturation point mentioned in the animal health section of this chapter was reached and R^2 was made to be unity. When the first three independent variables were included in the regression formula, 94 percent of the variation in the post-test scores was accounted for. The first three variables included in this analysis were semesters of vocational agriculture, class size, and verbal aptitude.

Table 42. Stepwise regression using class means for each independent variable for the small gasoline engines unit

Step	Variable	R^2	F to remove
1	Semesters of vocational agriculture	.64	17.61
2	Class size	.80	7.56
3	Verbal aptitude	.94	18.08
4	Total number of brothers and sisters	.96	3.00
5	Crop acres	.98	9.54
6	Semesters of science	.99	28.25
7	Animal units	.99	12.88
8	Teacher personality	.99	18.90
9	Social service interest	.99	124.34
10	Artistic interest	1.00	52.29

Ho_{27}: There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates.

Data in Table 39 present the mean pre-test, intelligence, and agricultural achievement scores for the field trip and control schools. The unadjusted and adjusted mean post-test scores for the small gasoline engines unit for these same schools are presented in Table 43. A difference of 6.97 points on the post-test in favor of the control schools was noted before the means were adjusted. After the means were adjusted, there was a

Table 43. Unadjusted and adjusted means for small gasoline engines post-test when pre-test, intelligence, and agricultural achievement scores were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	61.47	63.14
Control	68.44	66.77
Difference	6.97	3.63

difference of 3.63 points in favor of the control schools. An analysis of covariance was calculated on these post-test scores and is reported in Table 44. The null hypothesis was not rejected when a nonsignificant F-value (.47) was obtained. There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates.

Table 44. Analysis of covariance for the small gasoline engines post-test scores for the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	15.41	15.41	.47
Error	7	227.36	32.48	
Total	8	242.77		

Ho_{28}: There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when social service and artistic interest were used as covariates.

The stepwise regression that was presented in Table 40 identified the two interest variables (social service and artistic) that were used as the covariates in this hypothesis. The mean social service and artistic interest scores for the field trip and control schools are presented in Table 39. Data presented in Table 45 reveal the unadjusted and adjusted post-test means for the small gasoline engines unit. The differences between

Table 45. Unadjusted and adjusted means for small gasoline engines post-test when social service and artistic interests were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	61.47	62.06
Control	68.44	67.85
Difference	6.97	5.79

the post-test mean scores for the field trip and control schools were decreased from 6.97 to 5.79 points in favor of the control schools when the two interest factors (social service and artistic) were used as covariates. The analysis of covariance presented in Table 46 yielded a nonsignificant F-value (1.57) and the null hypothesis was not rejected. There were no differences between the mean scores for the small gasoline engines post-

Table 46. Analysis of covariance for the small gasoline engines post-test means when social service and artistic interests were used as covariates

Source of variation	Residuals d.f.	Residuals S.S.	Residuals M.S.	F
Technique	1	110.90	110.90	1.57
Error	8	564.96	70.62	
Total	9	675.86		

test in the field trip and control schools when social service and artistic interests were used as covariates.

Ho_{29}: There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when mechanical, abstract, and verbal aptitudes were used as covariates.

The means for the mechanical, abstract, and verbal aptitude variables are presented in Table 39 for the field trip and control schools. The unadjusted and adjusted post-test means, when differences in these aptitude factors were equated, are presented in Table 47 for the small gasoline engines unit. Examination of the data revealed that the difference between the post-test means decreased from 6.97 to 4.41 points after the use of the three aptitude variables. In this analysis, the control schools achieved higher than the field trips both before and after the post-test scores were adjusted.

An analysis of covariance was computed and is reported in Table 48.

Table 47. Unadjusted and adjusted means for small gasoline engines post-test when mechanical, abstract, and verbal aptitudes were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	61.47	62.75
Control	68.44	67.16
Difference	6.97	4.41

Table 48. Analysis of covariance for the small gasoline engines post-test scores for the field trip and control schools when mechanical, abstract, and verbal aptitudes were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	45.04	45.04	1.45
Error	7	217.07	31.01	
Total	8	262.11		

The null hypothesis was not rejected when a nonsignificant F-value (1.45) was obtained. There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when mechanical, abstract, and verbal aptitudes were used as covariates.

Ho_{30}: There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when crop acres, non-crop acres, and

animal units were used as covariates.

The mean number of crop acres, non-crop acres, and animal units are presented in Table 39 for the field trip and control schools. Data presented in Table 49 reveal the unadjusted and adjusted mean post-test scores in the small gasoline engines unit when crop acres, non-crop acres, and animal units were used as covariates. The control schools exceeded the

Table 49. Unadjusted and adjusted means for small gasoline engines post-test when crop acres, non-crop acres, and animal units were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	61.47	64.06
Control	68.44	65.85
Difference	6.97	1.79

field trip schools in achievement when the means were adjusted using characteristics of the home farm (crop acres, non-crop acres, and animal units). In Table 50 are the results of an analysis of covariance using the home farm characteristics mentioned above as covariates. The null hypothesis was not rejected when a nonsignificant F-value (2.51) was obtained. There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates.

Ho_{31}: There were no differences between the mean scores for the small gasoline engines post-test in the field trip and

Table 50. Analysis of covariance for the small gasoline engines post-test scores for the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	140.01	140.01	2.51
Error	7	390.11	55.73	
Total	8	530.12		

control schools when teacher knowledge, personality, tenure, and experience were used as covariates.

In Table 39, the mean values for the teacher factors (knowledge, personality, tenure, and experience) used as covariates in this hypothesis are presented. The unadjusted and adjusted mean post-test scores for the small gasoline engines unit, when the teacher factors are used as covariates, are presented in Table 51. The control schools had higher achievement than the

Table 51. Unadjusted and adjusted means for small gasoline engines post-test when teacher knowledge, personality, tenure, and experience were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	61.47	63.67
Control	68.44	66.24
Difference	6.97	2.57

field trip schools on both the unadjusted and adjusted post-test means. A nonsignificant F-value (.55) was reported in the analysis of covariance presented in Table 52 and the null hypothesis was not rejected. There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when teacher knowledge, personality, tenure, and experience were used as covariates.

Table 52. Analysis of covariance for the small gasoline engines post-test scores when teacher knowledge, personality, tenure, and experience were used as covariates

	Residuals			
Source of variation	d.f.	S.S.	M.S.	F
Technique	1	65.06	65.06	.55
Error	6	707.34	117.89	
Total	7	772.40		

Ho_{32}: There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when class and department size were used as covariates.

The means for class and department sizes are provided in Table 39 for the field trip and control schools. Information provided in Table 53 includes the unadjusted and adjusted mean post-test scores when the school factors, class and department size, were used as covariates. Examination of the mean post-test scores reveal that the field trip schools exceeded the scores of the control schools when the scores were adjusted on the

Table 53. Unadjusted and adjusted means for small gasoline engines post-test when class and department size were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	61.47	65.55
Control	68.44	64.36
Difference	6.97	1.19

basis of class and department size. A nonsignificant F-value (.02) was obtained in the analysis of covariance reported in Table 54 and the null hypothesis was not rejected. There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when class and department size were used as covariates.

Ho_{33}: There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when intelligence, number of brothers and

Table 54. Analysis of covariance for the small gasoline engines post-test scores for the field trip and control schools when class and department size were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	1.63	1.63	.02
Error	8	530.16	66.27	
Total	9	531.27		

sisters, teacher personality, and class size were used as covariates.

This analysis used four selected covariates to represent differences in the student, home, school, and teacher. The means for each of the four covariates (intelligence, number of brothers and sisters, teacher personality, and class size) are presented in Table 39. Data presented in Table 55 provide the unadjusted and adjusted mean post-test scores for the field

Table 55. Unadjusted and adjusted means for small gasoline engines post-test when intelligence, number of brothers and sisters, teacher personality, and class size were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	61.47	72.62
Control	68.44	57.29
Difference	6.97	15.33

trip and control schools. An analysis of covariance was calculated on the post-test means and is reported in Table 56 using the four covariates mentioned above. A nonsignificant F-value (1.80) was obtained and the null hypothesis was not rejected. There were no differences between the mean scores for the small gasoline engines post-test in the field trip and control schools when intelligence, number of brothers and sisters, teacher personality, and class size were used as covariates.

Table 56. Analysis of covariance for the small gasoline engines post-test scores for the field trip and control schools when intelligence, number of brothers and sisters, teacher personality, and class size were used as covariates

Source of variation	Residuals d.f.	S.S.	M.S.	F
Technique	1	59.63	59.63	1.80
Error	6	198.36	33.06	
Total	7	257.99		

Farm Credit

The means for the dependent variable (post-test) and the independent variables associated with the farm credit unit are presented in Table 57 for the field trip and control schools. The overall means for each of the variables are also provided. The effects of treatment were tested against variations in the basic observations, class means.

Ho_{34}: There were no differences between the mean pre-test scores of the field trip and control schools for the farm credit unit.

Data in Table 57 report the pre-test means for the farm credit unit in the field trip and control schools. The mean pre-test score for the field trip schools was 3.13 points higher than that for the control schools. A single classification analysis of variance was calculated to determine if there were any significant initial differences between the two treatment groups. This analysis of variance is reported in Table 58. The F-value obtained (.48) was nonsignificant and the null hypothesis was not rejected.

Table 57. Means for dependent and independent variables for the farm credit unit by instructional technique

Variable	Technique		Overall mean
	Field trip	Control	
Pre-test	51.52	48.39	49.96
Post-test	62.40	64.44	63.42
Intelligence quotient	104.65	104.77	104.71
Mechanical aptitude	54.26	52.37	53.32
Abstract aptitude	59.02	62.26	60.64
Verbal aptitude	47.75	45.47	46.61
Agricultural achievement	77.66	69.36	73.51
Outdoor interest	75.20	75.21	75.21
Mechanical interest	62.92	65.08	64.00
Computational interest	49.65	53.32	51.49
Scientific interest	37.05	41.56	39.31
Persuasive interest	50.54	50.08	50.31
Artistic interest	41.74	42.11	41.93
Literary interest	41.26	34.70	37.98
Social service interest	55.76	48.05	51.91
Clerical interest	52.33	59.87	56.10
Student skill sheet	30.89	30.73	30.81
Crop acres	239.02	259.48	249.25
Non-crop acres	66.97	49.72	58.35
Total farm acres	287.34	309.21	298.28
Animal units	135.00	158.24	146.62
Number of brothers and sisters	3.27	3.18	3.22
Semesters of science	4.79	3.64	4.22
Semesters of vocational agriculture	7.22	7.19	7.21
Teacher knowledge	30.50	29.33	29.92
Teacher personality	59.33	52.67	56.00
Class size	10.33	9.17	9.75
Department size	51.67	39.17	45.42
Teacher tenure	6.17	4.83	5.50
Teacher experience	8.00	6.83	7.42

There were no differences between the mean pre-test scores of the field trip and control schools for the farm credit unit.

Ho_{35}: There were no differences between the combined mean pre- and post-test scores of the field trip and control schools

Table 58. Analysis of variance on mean pre-test scores for the farm credit unit

Source of variation	d.f.	S.S.	M.S.	F
Technique	1	29.45	29.45	.48
Error	10	616.40	61.64	
Total	11	645.85		

for the farm credit unit.

Ho_{36}: There were no differences between the mean pre- and post-test scores of the field trip and control schools for the farm credit unit.

Ho_{37}: There were no differences between the magnitude of change from the mean pre- to post-test scores of the field trip and control schools for the farm credit unit.

A two-factor experiment using repeated measures was used to test the previous three hypotheses (Table 59). Two separate error terms were used in the analysis of variance as suggested by Winer (36) and explained in the animal health section of this chapter. In Ho_{35} the effects tested are confounded with the differences between the pre- and post-test means. The appropriate error term for this test was large and reduced the chance for significance. The error term used in testing Ho_{36} and Ho_{37} was not affected by the confounding and resulted in a more sensitive test. The first of the three null hypotheses (Ho_{35}) was not rejected as a nonsignificant F-value (.01) was obtained. There were no differences between the combined

Table 59. Analysis of a two-factor experiment using the repeated measures of class mean pre- and post-test scores for the farm credit unit

Source of variation	d.f.	S.S.	M.S.	F
Technique	1	1.79	1.79	.01
Error (a)	10	1421.40	142.14	
Time	1	1087.57	1087.57	60.63**
Technique x time	1	40.14	40.14	2.24
Error (b)	10	179.40	17.94	
Total	23	2730.30		

**Significant beyond the one percent level.

mean pre- and post-test scores of the field trip and control schools for the farm credit unit. The second hypothesis (Ho_{36}) was rejected when a highly significant F-value (60.63) was obtained. There were differences between the mean pre- and post-test scores of the field trip and control schools for the farm credit unit. The analysis of variance for the third hypothesis (Ho_{37}) provided a nonsignificant F-value (2.24) and the hypothesis was not rejected. There were no differences between the magnitude of change from the mean pre- to post-test scores of the field trip and control schools for the farm credit unit.

A stepwise regression using class means for each of the independent variables for the farm credit unit is reported in Table 60. In the analysis presented, five variables accounted for 98 percent of the variation in the data. The other independent variables did account for enough variation

Table 60. Stepwise regression using class means for each of the independent variables for the farm credit unit

Step	Variable	R^2	F to remove
1	Intelligence quotient	.63	17.21
2	Agricultural achievement	.77	5.68
3	Department size	.90	11.19
4	Pre-test	.95	4.96
5	Kuder-clerical	.98	7.77

in the post-test to enter into the regression equation. The R^2 for the first three variables (intelligence quotient, agricultural achievement, and department size) was .90.

Ho_{38}: There were no differences between the mean scores for the farm credit post-test in the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates.

The mean scores for the pre-test, intelligence, and agricultural achievement variables for the farm credit unit taught in the field trip and control schools are presented in Table 57. The unadjusted and adjusted means for these same schools are presented in Table 61. When the post-test scores were adjusted, using pre-test, intelligence, and agricultural achievement scores as covariates, the mean post-test score for the field trip schools exceeded those of the control schools by 10.40 points. An analysis of covariance was computed on these post-test scores and is re-

Table 61. Unadjusted and adjusted means for farm credit post-test when pre-test, intelligence, and agricultural achievement scores were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	62.40	58.22
Control	64.44	68.62
Difference	2.04	10.40

ported in Table 62. The null hypothesis was rejected when a significant F-value (8.09) was obtained. The mean score for the farm credit post-test in the control schools was significantly different from that of the field trip schools when pre-test, intelligence, and agricultural achievement scores were used as covariates.

Ho_{39}: There were no differences between the mean scores for the farm credit post-test in the field trip and control

Table 62. Analysis of covariance for the farm credit post-test scores for the field trip and control schools when pre-test, intelligence, and agricultural achievement scores were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	105.64	105.64	8.09*
Error	7	91.49	13.07	
Total	8	197.13		

*Significant beyond the five percent level.

schools when clerical interest scores were used as covariates.

The clerical interest factor used as covariate in this hypothesis was identified by the stepwise regression reported in Table 60. The mean scores for clerical interest are presented in Table 57 for the field trip and control schools. Unadjusted and adjusted post-test means in the farm credit unit are reported in Table 63. The mean difference in post-test

Table 63. Unadjusted and adjusted means for farm credit post-test when clerical interest was used as a covariate

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	62.40	63.34
Control	64.44	63.50
Difference	2.04	.16

scores between the field trip and control schools decreased from 2.04 to .16 points in favor of the control schools using clerical interest as a covariate. The null hypothesis was not rejected as a nonsignificant F-value (.00) was obtained on the analysis of covariance reported in Table 64. There were no differences between the mean scores for the farm credit post-test in the field trip and control schools when clerical interest scores were used as a covariate.

Ho_{40}: There were no differences between the scores for the farm credit post-test in the field trip and control schools

Table 64. Analysis of covariance for the farm credit post-test scores for the field trip and control schools when clerical interest scores were used as covariates

Source of variation	Residuals d.f.	S.S.	M.S.	F
Technique	1	.07	.07	.00
Error	9	916.38	101.82	
Total	10	916.45		

when mechanical, abstract, and verbal aptitudes were used as covariates.

Data in Table 57 report the mean scores for the field trip and control schools on the mechanical, abstract, and verbal aptitude variables. The unadjusted and adjusted mean scores for the farm credit post-test for the field trip and control schools are presented in Table 65. The differences between the mean post-test scores for the field trip and control schools

Table 65. Unadjusted and adjusted means for farm credit post-test when mechanical, abstract, and verbal aptitudes were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	62.40	61.91
Control	64.44	64.93
Difference	2.04	3.02

increased from 2.04 to 3.02 points. An analysis of covariance was used to analyze the post-test means and is presented in Table 66. A nonsignificant F-value (1.85) was obtained and the null hypothesis was not rejected. There were no differences between the mean scores for the farm credit post-test scores in the field trip and control schools when mechanical, abstract, and verbal aptitudes were controlled.

Table 66. Analysis of covariance for the farm credit post-test scores for the field trip and control schools when mechanical, abstract, and verbal aptitudes were used as covariates

		Residuals		
Source of variation	d.f.	S.S.	M.S.	F
Technique	1	107.19	107.19	1.85
Error	7	405.65	57.95	
Total	8	512.84		

Ho_{41}: There were no differences between the mean scores for the farm credit post-test scores in the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates.

The mean numbers of crop acres, non-crop acres, and animal units are reported in Table 57. The unadjusted and adjusted means for the field trip and control schools are reported in Table 67. When the post-test means were adjusted, it was revealed that achievement in the control schools exceeded that of the field trip schools by 1.74 points.

In Table 68 is an analysis of covariance using crop acres, non-crop

Table 67. Unadjusted and adjusted means for farm credit post-test when crop acres, non-crop acres, and animal units were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	62.40	62.55
Control	64.44	64.29
Difference	2.04	1.74

acres, and animal units as covariates. The F-value was nonsignificant (.00) and the null hypothesis was not rejected. There were no differences between the mean scores for the farm credit post-test in the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates.

Ho_{42}: There were no differences between the mean scores for the farm credit post-test in the field trip and control

Table 68. Analysis of covariance for the farm credit post-test scores for the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates

Source of variation	Residuals			
	d.f.	S.S.	M.S.	F
Technique	1	.48	.48	.00
Error	7	832.23	118.89	
Total	8	832.71		

schools when teacher knowledge, personality, tenure, and experience were used as covariates.

The means for the teacher variables that were used as covariates in this hypothesis are presented in Table 57. Unadjusted and adjusted means are indicated in Table 69 for the farm credit post-test scores. Examination of the mean post-test scores reveal that the mean difference decreased from 2.04 to 1.34 points for the farm credit unit.

Table 69. Unadjusted and adjusted means for farm credit post-test when teacher knowledge, personality, tenure, and experience were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	62.40	62.75
Control	64.44	64.09
Difference	2.04	1.34

An analysis of covariance was calculated to determine if there were differences between the adjusted means. The F-value presented (.27) in Table 70 was nonsignificant and the null hypothesis was not rejected. There were no differences between the mean scores for the farm credit post-test in the field trip and control schools when teacher knowledge, personality, tenure, and experience were used as covariates.

Ho_{43}: There were no differences between the mean scores for the farm credit post-test in the field trip and control schools when class and department size were used as

Table 70. Analysis of covariance for the farm credit post-test scores for the field trip and control schools when teacher knowledge, personality, tenure, and experience were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	32.24	32.24	.27
Error	6	712.20	118.70	
Total	7	744.44		

covariates.

Data in Table 57 present the mean sizes of classes and departments in the field trip and control schools. The unadjusted and adjusted mean scores for the post-test in the field trip and control schools when class and department size were used as covariates were presented in Table 71.

The mean post-test scores were analyzed by the analysis of covariance technique and is reported in Table 72. A nonsignificant F-value (5.08) was obtained and the null hypothesis was not rejected. However, this value

Table 71. Unadjusted and adjusted means for farm credit post-test when class and department size were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	62.40	70.91
Control	64.44	55.93
Difference	2.04	14.98

Table 72. Analysis of covariance for the farm credit post-test scores for the field trip and control schools when class and department size were used as covariates

Source of variation	Residuals d.f.	S.S.	M.S.	F
Technique	1	215.72	215.72	5.08
Error	8	339.68	42.46	
Total	9	555.40		

approached the five percent level of confidence (5.32). There were no differences between the mean scores for the farm credit post-test in the field trip and control schools when class and department size were used as covariates.

Ho_{44}: There were no differences between the mean scores for the farm credit post-test in the field trip and control schools when agricultural achievement, non-crop acres, department size, and teacher tenure were used as covariates.

The four covariates used in this analysis were selected to control for initial differences in the student, home, school, and teacher. The means for these covariates are presented in Table 57. The unadjusted and adjusted mean post-test scores for the farm credit unit in the field trip and control schools are reported in Table 73. An initial difference of 2.04 points in favor of the control schools was noted in the mean post-test scores. After adjusting the means, a difference of 8.54 points in favor of the field trip schools was observed.

Table 73. Unadjusted and adjusted means for farm credit post-test when agricultural achievement, non-crop acres, department size, and teacher tenure were used as covariates

Technique	Mean post-test scores	
	Unadjusted	Adjusted
Field trip	62.40	67.69
Control	64.44	59.15
Difference	2.04	8.54

An analysis of covariance was computed on the post-test means for the farm credit unit and is reported in Table 74. A nonsignificant F-value (1.45) was obtained and the null hypothesis was not rejected. There were no differences between the mean scores for the farm credit post-test in the field trip and control schools when agricultural achievement, non-crop acres, department size, and teacher tenure were used as covariates.

Table 74. Analysis of covariance for the farm credit post-test scores for the field trip and control schools when agricultural achievement, non-crop acres, department size, and teacher tenure were used as covariates

Source of variation	Residuals			F
	d.f.	S.S.	M.S.	
Technique	1	36.66	36.66	1.45
Error	6	152.10	25.35	
Total	7	188.76		

DISCUSSION

The general purpose of this study was to determine the effect of field trips on student achievement in each of the four subject matter areas of vocational agriculture. The effects of field trips on student achievement were also studied using certain student, home, school, and teacher factors as covariates.

Since randomization was used to select the schools involved in this study, the data were analyzed using the class means as the basic observations. There are some inherent dangers in using means as the basic obervations. The mean is a reliable statistic in most cases because it uses all of the available information in a set of data. However, the mean is sensitive and may yield unrealistic results when extremes are encountered.

The first analysis conducted was an analysis of variance to see if there were initial differences in student knowledge between the two instructional techniques. Nonsignificant F-values were obtained for the animal health, commercial fertilizers, small gasoline engines, and farm credit units indicating that the mean pre-test scores were not different. Randomness appeared to be successful in selecting schools for inclusion in the study whose students were similar in prior knowledge of the specific subject matter to be studied.

A two-factor experiment using the repeated measures of pre- and post-test scores was used to determine if the magnitude of the mean pre-test scores were different for the field trip and control schools. The results of this analysis did not indicate significant differences between the two instructional techniques. The two-factor experiment also provided a test

to determine if there were differences between the mean pre- and post-test scores for the field trip and control schools. Significant differences were noted between the mean pre- and post-test scores in each of the four subject matter areas. These results indicated that field trips were effective instructional techniques in all four subject matter areas considered in this study (animal health, commercial fertilizers, small gasoline engines, and farm credit). It should be kept in mind, however, that field trips are not the only instructional technique available for the teacher to use. It is a common practice for teachers to use a variety of methods and techniques in their instructional programs. This study supports the view that field trips are one of the effective methods from which a teacher may choose.

A stepwise regression was conducted to identify the variables that could be used to account for the variation in the mean post-test scores. In the animal health, commercial fertilizers, and small gasoline engines units, the regression equation added variables until the tenth step when the regression equation fit the data exactly. However, the perfect fit was due to the fact that the equation had used the full number of parameters in the model and was of no particular significance other than the ordering of the importance of the variables. In the farm credit unit, the stepwise regression stopped after the fifth variable had entered the equation. The R^2 with the five variables for the farm credit unit was .98.

The first three variables in the stepwise regression for each of the subject matter areas accounted for at least 90 percent of the variance in the mean post-test scores. It is observed that each subject matter area had a different combination of variables that accounted for the variance in

the post-test scores. When all four stepwise regressions were compared, it was noted that two variables (social service interest and semesters of vocational agriculture) were included in the equations for three of the subject matter areas. Seven variables (crop acres, scientific interest, total farm acres, pre-test, agricultural achievement, class size, and clerical interest) were included in the regression equations for two of the subject matter areas. The variables that entered the regression equations indicated to the researcher that student achievement was the product of many factors and that these factors were not the same for each subject matter area. It was particularly interesting to note that intelligence scores entered the regression equation in the farm credit unit only.

Many teachers of vocational agriculture are faced with the problems of adapting their instructional programs to flexible modular scheduling involving large group instruction, small group instruction, and independent student study. The stepwise regression equations for the four subject matter areas identified several variables that teachers may not have taken into consideration in planning instructional programs. Planning small group instruction and independent student study should take into consideration many variables if the instruction is to be of maximum benefit to the student. Permanent records including socio-economic information as well as the usual information (academic, interests, and aptitudes) need to be developed and utilized by teachers in planning instructional programs.

An analysis of covariance was conducted in each of the four subject matter areas using the academic ability variables of pre-test, intelligence, and agricultural achievement scores as covariates. The adjusted mean post-test scores of the students in the control schools were higher

than those in the field trip schools for the animal health, small gasoline engines, and farm credit units. In the animal health and farm credit units, the mean academic ability variables for the field trip schools were equal or superior to those of the control schools and resulted in a downward adjustment of the mean post-test scores. The field trip schools were superior to the control schools in the small gasoline engines unit on two variables (pre-test and agricultural achievement scores). However, the mean intelligence score in the control schools was higher than that of the field trip schools. These differences resulted in an upward adjustment of the mean post-test scores for the field trip schools in the small gasoline engines unit. The initial difference in the mean post-test scores were too great and achievement in the control schools remained superior to that of the field trip schools. After adjusting the commercial fertilizers mean post-test scores using the academic ability variables, the student achievement was higher in the field trip schools than in the control schools. The mean scores for each of the three academic ability variables (pre-test, intelligence, and agricultural achievement) was lower for the field trip schools than for the control schools for the commercial fertilizers unit. These lower scores resulted in an upward adjustment of the mean post-test scores. The use of field trips in teaching the commercial fertilizers unit has been a commonly used instructional technique. If the teachers had used field trips in their regular teaching of commercial fertilizers, it is only natural that their students might be expected to achieve higher in this area. Likewise, the control schools might have been at a distinct disadvantage in not being able to use field trips and the achievement of their students may have been lowered.

The effects of field trips on student achievement when certain interest factors were controlled were studied using an analysis of covariance. A total of nine separate interest scores were available for use as covariates. Since schools were randomly selected, the class means were used as the basic observation and the total degrees of freedom were limited to 11. One degree of freedom was lost in the analysis of covariance for each covariate that was used. The small number of degrees of freedom made it impractical to use all of the interest factors as covariates. Therefore, stepwise regression analyses were used to identify those interest factors that were to be used as covariates. Each of the four subject matter areas had a different set of interest factors that were used as covariates. This indicated to the researcher that there are different interest factors associated with student achievement. Social service interest was used as a covariate for the animal health, commercial fertilizers, and small gasoline engines units. In all three of these areas the subject matter pertained to helping people with their problems. Material in the farm credit was more closely identified with individual problems and the social service interest did not enter the regression equation. Scientific interests were used as covariates in the animal health and commercial fertilizers units. These two units are scientifically oriented and the use of scientific interest as a covariate was logical. Clerical interests were used as covariates in the commercial fertilizers and farm credit unit. In both of these units, it was necessary to fill out forms and the association of clerical interest with post-test achievement was not unusual. The results of the analysis of covariance indicated that interest scores were not influencing the data enough to adjust the scores a significant amount. A lack of consistency in

the effects of these covariates on the field trip and control schools may have been a factor which resulted in the F-value of .00 in the analysis of covariance.

The mean post-test scores were also equated using mechanical, abstract, and verbal aptitude scores as covariates. The means were adjusted upwards in the field trip schools for the animal health and small gasoline engines units, but the adjustment did not exceed the achievement of the control schools. In the commercial fertilizers unit, an upward adjustment resulted in the mean post-test scores for the field trip schools exceeding those of the control schools by 9.93 points. The mean post-test scores were adjusted downward in the field trip schools for the farm credit unit. The mean scores in the field trip schools and control schools were similar for all the subject matter areas except commercial fertilizer. The mean scores for the aptitude variables for the commercial fertilizers unit were considerably higher in the control schools than in the field trip schools.

The three variables used to equate differences in the home farm were crop acres, non-crop acres, and animal units. The use of these variables resulted in the adjusted mean post-test scores in the field trip schools exceeding those in the control schools for the animal health and commercial fertilizers unit. However, this same adjustment in the small gasoline engines and farm credit units did not change the means sufficiently to overcome the initial superiority of the control schools. These data suggest that the use of field trips may be of particular importance in the teaching of students who are lacking in the experiences normally associated with the unit being studied. This appears to be particularly true for students in the freshman and sophomore grade levels who have not had the experiences of

students at the junior and senior grade level. In addition, the freshman and sophomore students may not have been ready to accept the responsibility often given to junior and senior students. This might seriously limit the experiences of the younger students. By using field trips, the teacher may have been able to provide experiences that the students in the field trip schools could draw upon in later classes. Those students in the freshman and sophomore classes in the control schools would not have been able to draw upon these types of experiences and, in turn, their achievement may have been lowered.

It is difficult to measure the true effectiveness of a teacher in the classroom. The measures that were used to control for teacher differences in this study included knowledge of the subject matter being taught, personality inventory, tenure in the present school, and total years of teaching experience. Analyses of covariance, using the teacher variables as covariates, were conducted in each of the four subject matter areas. The adjusted means in the field trip schools were higher than those in the control schools for the animal health and commercial fertilizers units. The adjusted means in the control schools were higher than in the field trip schools in the small gasoline engines unit. It may have been that the younger students relied quite heavily upon the instructor and the instructional techniques, whereas, the older students were able to rely on the basic reference material to a greater extent. Another possible explanation was that freshman and sophomore students were more excited about school work and welcomed the opportunity that the field trip presented to them. The junior and senior students may have experienced a larger number of field trips in their previous classes and the novelty of the field trip had

schools were not significant for the animal health, small gasoline engines, and farm credit units. A highly significant difference between the mean post-test scores for the commercial fertilizers unit was obtained. These results indicated that individual differences in the student, home, school, and teacher need to be considered in planning instructional programs. This experiment was conducted using four specific subject matter areas as representative of each of the four grade levels in vocational agriculture. If these four subject matter areas are representative of the four grade levels, then it can be said that when students in vocational agriculture are taught using field trips they achieve as well as or better than students taught without the use of field trips.

The four post-tests used to measure the effectiveness of field trips on instruction in vocational agriculture were found to be reliable and valid. However, it is difficult to measure the degree of proficiency that a student possesses with an objective test. It would have been desirable to measure student proficiency in performing skills taught in each of the four subject matter areas. A lack of resources and personnel did not allow the researcher to develop measurement instruments of this type.

The geographic locations of the participating schools may have also affected student attainment. The field trip schools were distributed throughout the entire state. All but one of the control schools were located in the northwestern part of Iowa. The northwestern part of the state is one of large and productive farms, and the achievement of students in schools located in this area may have been influenced. Schools located in other areas of the state may have had small and part-time farmers. The average farm size in the field trip school area was less than that in the

control school area.

The use of four field trips in each of the four subject matter areas during the three-week unit of instruction may have been overuse of this instructional technique. The average number of field trips used in most vocational agriculture classes during the entire year has been only three or four.

The field trips were not to the same places for each class due to the different locations of the schools, and it was difficult to get uniform application of the treatment. Some of the field trips were undoubtedly better than others. The enthusiasm of the person whom they visited on the field trip also probably influenced student achievement.

The weather could also have been an influencing factor. If the weather was unpleasant during the time of the field trip, the students undoubtedly did not benefit as much from the field trip as they would have had the weather been nicer.

The six instructors who used field trips may have been at a disadvantage when they were asked to use field trips in areas where they may not have used them normally. Also, the instructors received only limited training in the use of field trips. It is understandable that some of the instructors may not have been as familiar with the use of field trips as they should have been.

The conditions present in each local school may also have affected the student achievement. The general atmosphere in the classroom during the three-week period could have greatly affected the results of this study. The general attitude of the students in a particular school may have influenced the data that were collected during the experiment. Other factors

in the school, of which the researcher was not aware, may also have influenced the student achievement.

The results of this study suggest additional research is needed to determine the effectiveness of field trips on instruction in vocational agriculture. This study should be replicated to check the validity of the findings presented in this investigation. In addition, it would be desirable to replicate this study in other states to determine if the findings presented in this study are representative of the results that might be obtained in other areas of the country. It would also be desirable to conduct a similar study using other subject matter areas.

Additional research is needed on the different uses of field trips. The effectiveness of field trips to motivate, introduce, and summarize should also be examined. A study of different ways of structuring field trips would also be of interest.

A similar study, conducted over a longer period of time, would be beneficial. An experiment conducted over a longer period of time may produce different results than were obtained in this investigation.

In an attempt to equate the two groups in relationship to farm characteristics, it may be desirable to replicate this study using a random sample stratified by economic areas. Another alternative, to obtain more uniform farm characteristics, would be to increase the number of schools in each group so that the principle of randomness would have a better chance to equate the two groups.

A pilot study may also be desirable. This pilot study could be used to test the validity and reliability of the measurement instruments more carefully and to find weaknesses in the instructional techniques and refer-

ence materials. The limitations of available time, labor, and money made a pilot study impossible in the present study.

An attitudinal scale would be desirable in a future study. This scale could be used to determine if the attitude of the students and teachers in the treatment group differ from that of those in the control group. Student achievement may have been influenced by the attitude of the student toward the instructional technique being used.

A desirable outgrowth of this study was the emphasis that it placed on improving instruction in vocational agriculture. A workshop on instructional techniques and resources, attended by more than 150 teachers, was conducted by the project staff members after the experiment was completed. Those teachers directly involved in the experiment may also have examined the techniques and resources that they were using more closely after completing the experiment.

Teacher education programs in agriculture should include instruction on the proper use of field trips in instructional programs dealing with production and off-farm agriculture. Emphasis needs to be placed on the application of the field trip to the specific instructional areas of animal science, agronomic science, agricultural mechanics, and agricultural economics. In-service educational programs should include professional courses and appropriate instruction in technical agriculture. The professional courses should include a methods course which would contain information on the planning, conducting, and evaluating of field trips. Greater emphasis should also be placed on involving the student in the learning process.

Experiences in the student teaching program should include the use of

field trips in each of the subject matter areas. Careful and coordinated planning by staff members in agricultural education, cooperating teachers, and the student teacher are necessary if these experiences are to be successful. Some consideration should also be given to lengthening the student teaching program so that the student teacher can become more experienced in the use of the various teaching methods and techniques. Student teachers should be encouraged to involve the learner in the learning process. Class field trips provide an effective tool to bring this about.

SUMMARY

The general purpose of this study was to determine the effect of field trips on student achievement in each of four subject matter areas of vocational agriculture. This investigation was conducted as a part of a larger project entitled, "An Experimental Evaluation of the Effectiveness of Selected Techniques and Resources on Instruction in Vocational Agriculture." This larger study was funded by a research grant obtained from the Iowa Department of Public Instruction, Division of Vocational Education from ancillary funds provided by the Vocational Education Act of 1963.

A list of Iowa high schools offering an approved four-year program in vocational agriculture was obtained. From this list, six schools were randomly assigned to each of seven treatment groups and a control group. In order to be included in this study a department must have had a minimum enrollment of 35 students with 7 to 22 students in each class and whose instructors had at least one year of teaching experience. The experimental design used in this study was the pre-test versus post-test control group design. The six schools assigned to the treatment (field trip) group and six schools assigned to the control group were used as the basis for comparisons in this study.

Project staff members selected units of instruction for each of the four grade levels. These units of instruction included animal health for the ninth grade, commercial fertilizers for the tenth grade, small gasoline engines for the eleventh grade, and farm credit for the twelfth grade.

A three-week teaching outline was developed which included the overall objectives, specific day-by-day objectives, and reading assignments for

each of the four units. All twelve schools that participated in the experiment were provided with the same reference material and varied their instruction only in the use of field trips by the six treatment schools.

A total of four field trips were planned for each of the units of instruction. They consisted of planned visits to points outside of the classroom or shop that could be completed in a regular class period. These field trips were to farms and agricultural businesses available in the community.

A 60-item test was developed by project staff members who were not associated with the seven instructional techniques being tested and was administered as both the pre-test and post-test.

The participating teachers received two training sessions prior to the experiment. The first meeting was held to explain the purposes and design of the study and explain the controls imposed on the experiment. A second meeting with the teachers was held to familiarize the teachers with the experimental techniques and resources to be tested and train them in the use of their respective technique or resource.

Information concerning each of the students was collected over a two month period prior to the beginning of the experiment. The information was obtained by having the school counselor in each of the schools administer the following tests: (1) Otis Quick-Scoring Mental Ability, (2) Kuder General Interest Survey, (3) Nebraska Agriculture Achievement, and (4) Differential Aptitude Test-Mechanical, Abstract, and Verbal Sections.

Data on the students socio-economic backgrounds were collected by questionnaire. In addition, each of the students was asked to indicate which of a selected list of activities they had performed in the appropri-

ate subject matter area.

Measures taken on the teacher included the Minnesota Teacher Attitude Inventory and a pre- and post-test on teacher knowledge in each of the four subject matter areas. Additional information collected on the teacher included total years of teaching experience, years of tenure at present school, and educational level.

The experiment was conducted over a three-week period beginning March 21, 1969. During the experiment the instructors followed the outlines provided for each of the units of study and taught as they would normally teach that unit injecting the use of the instructional media on the predetermined days. The only other limitation placed on the teacher was that he was not to use any of the other media being tested in the larger experiment.

The data gathered from the schools were coded and placed on IBM cards. The class means were then computed for each of the variables and this information was coded and placed on data processing cards for analyses. The analyses conducted in this study used class means as the basic observation since the schools were randomly selected. The statistical methods used in analyzing the data included analysis of variance, analysis of covariance, a two-factor experiment with repeated measures, and stepwise regression.

An analysis of variance was conducted on the mean pre-test scores for each of the four subject matter areas. No significant differences were found between the mean pre-test scores in the field trip and control schools for the animal health, commercial fertilizers, small gasoline engines, and farm credit units. The schools selected for inclusion in this study were similar in the student's prior knowledge of the specific matter

studied.

Analyses for the two-factor experiment using the repeated measures of mean pre- and post-test scores were conducted for the animal health, commercial fertilizers, small gasoline engines, and farm credit units. No significant differences were observed between the combined mean pre- and post-test scores of the field trip and control schools for the four subject matter areas. In all four of the subject matter areas, significant differences were observed between the mean pre- and post-test scores in the field trip and control schools. This result indicated that a significant gain in knowledge occurred between the time of the pre- and post-tests. When the magnitude of change from the mean pre- to post-test scores in the field trip and control schools for each of the subject matter areas were analyzed, no significant differences were observed.

In each of the four subject matter areas, a stepwise regression analysis was calculated. In each of the four subject matter areas different variables were found to contribute to the variations in the post-test scores. Variables associated with the post-test scores for animal health included: crop acres, mechanical aptitude, semesters of vocational agriculture, scientific interest, teacher knowledge, teacher experience, social service interest, persuasive interest, non-crop acres, and total farm acres. In the commercial fertilizers unit, the variables included in the stepwise regression analysis were: pre-test, social service interest, agricultural achievement, teacher tenure, semesters of vocational agriculture, class size, total farm acres, scientific interest, clerical interest, and computational interests. The stepwise regression analysis for the farm credit unit included only five variables. These variables were: intelli-

gence, agricultural achievement, department size, pre-test, and clerical interest. In each of the four subject matter areas, the R^2 for the first three variables was at least .90.

The effect of field trips on student achievement when certain academic ability factors were controlled was studied by means of analysis of covariance. The academic ability factors used as covariates included: pre-test, intelligence, and agricultural achievement. A significant difference was observed between the adjusted mean post-test scores in the field trip and control schools for the farm credit unit. The mean post-test score for the control schools was 10.40 points higher than that of the field trip schools. In the remaining three subject matter areas, no significant differences were observed between the mean post-test scores in the field trip and control schools. The adjusted mean post-test scores in the control schools were higher than those in the field trip schools for the animal health and small gasoline engines units. In the commercial fertilizers unit, the adjusted means were higher in the field trip schools than in the control schools.

Interest factors were used as covariates in another analysis of the effect of field trips on student achievement in vocational agriculture. The interest factors used as covariates for each of the subject matter areas were identified in the stepwise regression for the appropriate subject matter areas. The adjusted mean post-test score in the control schools was higher than that in the field trip schools for each of the subject matter areas. However, the differences between the field trip and control schools were not statistically significant when certain interest factors were controlled in each of the subject matter areas.

Mechanical, abstract, and verbal aptitudes were used as covariates in analyzing the effect of field trips on student achievement in each subject matter area. The adjusted mean post-test scores in the control schools were higher than those in the field trip schools for the animal health, small gasoline engines, and farm credit units. The adjusted mean post-test score in the field trip schools was 9.93 points higher than that in the control schools for the commercial fertilizers unit. Analyses of covariance conducted on the mean post-test scores revealed no significant differences between the mean post-test scores in the field trip and control schools for each subject matter area when mechanical, abstract, and verbal interests were used as covariates.

The effect of the home farm on student achievement was controlled by using crop acres, non-crop acres, and animal units as covariates in the analysis made in each of the four subject matter areas. The results of these analyses indicated achievement in the field trip schools was higher than achievement in the control schools for the animal health and commercial fertilizers units. In the small gasoline engines and farm credit units, the achievement in the control schools was higher than the achievement in the field trip schools. There were no significant differences between the mean post-test scores for the animal health, commercial fertilizers, small gasoline engines, and farm credit units in the field trip and control schools when crop acres, non-crop acres, and animal units were used as covariates.

An analysis, using teacher knowledge, personality, tenure, and experience as covariates, was conducted in each of the subject matter areas. The result of these analyses indicated that the adjusted mean post-test scores

in the field trip schools were superior to those in the control schools for the animal health and commercial fertilizers units. The adjusted mean post-test scores in the control schools were higher than those in the field trip schools for the small gasoline engines and farm credit units. The differences between mean post-test scores in the field trip and control schools were not statistically significant when certain teacher factors were used as covariates for the animal health, commercial fertilizers, small gasoline engines, and farm credit units.

Differences in class and department sizes were equated in an analysis of covariance in each of the four subject matter areas. In all cases, the adjusted mean post-test scores in the field trip schools were higher than those in the control schools. The analysis of covariance conducted in each subject matter area did not reveal any significant differences between the two types of schools when class and department size were used as covariates.

Four selected variables were used as covariates in the final analysis of each subject matter area. These four variables were selected to equate differences that existed in the student, home, school, and teacher. A separate set of variables was selected for each subject matter area. The four variables selected for the animal health unit were agricultural achievement, animal units, department size, and teacher tenure. The adjusted mean post-test score in the control schools was higher than that in the field trip schools. These differences were not statistically significant. In the commercial fertilizers unit, abstract aptitude, crop acres, department size, and teacher tenure were used as covariates. The adjusted mean post-test scores in the field trip schools was 19.83 points higher than that in

the control schools. The F-value obtained indicated that this difference was highly significant. Intelligence, number of brothers and sisters, teacher personality, and class size were the four variables selected as covariates for the small gasoline engines unit. The adjusted mean post-test score in the field trip schools was 15.33 points higher than that in the control schools. The results of the analysis of covariance revealed that these differences were not statistically significant. The adjusted mean post-test score in the field trip schools was 8.54 points higher than that in the control schools when agricultural achievement, non-crop acres, department size, and teacher tenure were used as covariates. A nonsignificant F-value in the analysis of covariance indicated that these scores were also not statistically different.

The findings of this study may be summarized in the following statements:

1. There were no differences between the mean pre-test scores in the field trip and control schools for each subject matter area.
2. Statistical analyses of all subject matter areas did not indicate any differences in the magnitude of change in knowledge from the pre- to post-test between the field trip and control schools.
3. Both the field trip and control schools had a significant gain in knowledge during the time of the experiment.
4. The variables affecting student achievement were different for each subject matter area.
5. The control schools achieved significantly higher than field trip schools in the farm credit unit when academic ability factors were used as covariates. There were no differences in student achieve-

ment for commercial fertilizers, small gasoline engines, and farm credit units when academic ability factors were used as covariates.

6. The difference between the field trip and control schools were not statistically significant when certain interest, aptitude, socio-economic, teacher, and school factors were controlled in each subject matter area.
7. A highly significant difference, in favor of the field trip schools, was obtained for the commercial fertilizers unit when abstract aptitude, crop acres, department size, and teacher tenure were used as covariates. No significant differences were observed between the field trip and control schools when selected student, home, school, and teacher variables were used as covariates for the animal health, small gasoline engines, and farm credit units.

The results of this study indicate that field trips are effective instructional techniques that should be encouraged and promoted in the teaching of vocational agriculture. Information gained from this study should provide guidance in the planning and use of field trips by vocational agriculture teachers, school administrators, teacher educators, and other educational personnel.

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APPENDIX A: TEACHING OUTLINES

ANIMAL HEALTH

ANIMAL HEALTH

Problem Area Outline by Days

Day	
1	The Economic Importance of Livestock Diseases and Parasites
2	Factors in Maintaining Animal Health
3 & 4	Causes, Symptoms, Prevention and Control of Major Cattle Diseases
5	Life Cycles, Symptoms, Prevention and Control of Major Cattle Parasites
6 & 7	Causes, Symptoms, Prevention and Control of Major sheep Diseases
8	Life Cycles, Symptoms, Prevention and Control of Major Sheep Parasites
9 & 10	Casues, Symptoms, Prevention and Control of Major Swine Diseases
11	Life Cycles, Symptoms, Prevention and Control of Major Swine Parasites
12	Planning a General Livestock Health Program
13	Occupational Roles of the Veterinarian, Farmer, and Other Animal Health Workers
14	Summary and Review
15	Post-Test

ANIMAL HEALTH

Behavioral Objectives: (understandings and abilities)

Understanding of:

1) The relation between control of diseases and parasites with efficient production of livestock

2) The types, causes, symptoms, prevention and control of the major diseases and parasites of livestock

3) The occupational roles of the veterinarian, farmer, and other animal health workers

4) The possibilities for employment in occupations requiring a knowledge of animal diseases and parasites

Ability to:

1) Recognize normal and abnormal health conditions prevalent in livestock and livestock production

2) Plan an effective program for controlling livestock diseases and parasites

3) Maintain desirable animal health conditions for livestock

ANIMAL HEALTH

Day 1

1. PROBLEM AREA: The Economic Importance of Livestock Diseases and Parasites

Objectives:

To develop an understanding of:

a. The importance of livestock diseases and parasites upon profitable livestock production
b. The amount of damage done to livestock and livestock products by diseases and parasites
c. The cost of controlling livestock diseases and parasites

References:

a. Animal Health, Ch. 1, pp. 1-6
b. Animal Health Handbook, pp. 2-3

Day 2

2. PROBLEM AREA: Factors in Maintaining Normal Animal Health

Objectives:

To develop an understanding of:

a. The physical characteristics of the healthy animal
b. Characteristics that indicate abnormal health and behavior of animals
c. Proper management steps in preventing and controlling livestock diseases and parasites
d. Desirable livestock health conditions

To develop an ability to:

a. Recognize normal and abnormal livestock and livestock conditions
b. Determine when an animal needs medical attention

References:

a. Animal Health, Ch. 2, pp. 7-12
b. Animal Health Handbook, pp. 43-45, 49-50, 87-90, 93-95, 105-106, 109-110

ANIMAL HEALTH

Days 3 and 4

3. PROBLEM AREA: Causes, Symptoms, Prevention, and Control of Major Cattle Diseases

Objectives:

To develop an understanding of:

a. The types of cattle diseases
b. Causes, symptoms, treatment, and prevention of the following diseases of cattle:

1. Brucellosis
2. Shipping Fever Complex
3. Foot Rot
4. Pinkeye
5. Ringworm
6. Mastitis
7. Leptospirosis
8. Calf Scours
9. Warts
10. Pneumonia
11. Milk Fever
12. Ketosis
13. Bloat

To develop an ability to recognize conditions of cattle that warrant calling a veterinarian

References:

a. Animal Health, Ch. 3, pp. 13-17; Ch. 4, pp. 18-29

Day 5

4. PROBLEM AREA: Life Cycles, Symptoms, Prevention, and Control of Cattle Parasites

Objectives:

To develop an understanding of:

a. The types of cattle parasites
b. The life cycles, symptoms, prevention, and control of major cattle parasites

1. Screw worms
2. Grubs
3. Flies
4. Stomach worms
5. Lice

To develop an ability to:

a. Recognize parasite infestations in cattle
b. Treat cattle parasites
c. Control cattle parasites

ANIMAL HEALTH

Day 5 (continued)

References:

a. Animal Health, Ch. 7, pp. 49-52; Ch. 8, pp. 53-58

Days 6 and 7

5. PROBLEM AREA: Causes, Symptoms, Prevention, and Control of Major Sheep Diseases

Objectives:

To develop an understanding of:

a. The types of sheep diseases
b. Causes, symptoms, treatment, and prevention of the following diseases of sheep:

1. Foot Rot
2. Mastitis
3. Sore Mouth
4. Overeating Disease
5. Lambing Paralysis
6. Bloat

To develop an ability to recognize disease conditions in sheep that warrant calling a veterinarian

References:

a. Animal Health, Ch. 3, pp. 13-17; Ch. 5, pp. 30-35

Day 8

6. PROBLEM AREA: Life Cycles, Symptoms, Prevention, and Control of Major Sheep Parasites

Objectives:

To develop an understanding of:

a. The types of sheep parasites
b. The life cycles, symptoms, prevention, and control of the following major sheep parasites:

1. Screw Worm
2. Lice
3. Ticks
4. Scabbies
5. Stomach Worm
6. Tapeworms
7. Coccidiosis

ANIMAL HEALTH

Day 8 (continued)

Objectives: (continued)

To develop an ability to:

a. Recognize animal parasite infestations in sheep
b. Treat sheep parasites
c. Control sheep parasites

References:

a. Animal Health, Ch. 7, pp. 49-50; Ch. 9, pp. 59-66

Days 9 and 10

7. PROBLEM AREA: Causes, Symptoms, Prevention, and Control of Major Swine Diseases

Objectives:

To develop an understanding of:

a. The types of swine diseases
b. Causes, symptoms, treatment, and prevention of the following diseases of swine:

1. Cholera
2. Erysipelas
3. Chronic Mycoplasmal Pneumonia
4. Atrophic Rhinitis
5. Brucellosis
6. Flu
7. TGE
8. Leptospirosis
9. MMA

To develop an ability to recognize disease conditions in swine that warrant calling a veterinarian

References:

a. Animal Health, Ch. 3, pp. 13-17; Ch. 6, pp. 36-48

ANIMAL HEALTH

Day 11

8. PROBLEM AREA: Life Cycles, Prevention and Control of Major Swine Parasites

Objectives:

To develop an understanding of:

a. The types of swine parasites
b. The life cycles, symptoms, prevention, and control of the following major swine parasites:

1. Ascarids
2. Lungworms
3. Mange
4. Lice

To develop an ability to:

a. Recognize parasite infestations in swine
b. Treat swine parasites
c. Control swine parasites

References:

a. Animal Health, Ch. 7, pp. 49-50; Ch. 10, pp. 67-71

Day 12

9. PROBLEM AREA: Planning a General Livestock Health Program

Objectives:

To develop an understanding of:

a. The role of sanitation in an animal health program
b. The importance of preventive medicine

To develop an ability to:

a. Plan general livestock health programs
b. Evaluate current livestock health programs

References:

a. Animal Health, Ch. 11, pp. 73-80
b. Animal Health Handbook, pp. 6-7

ANIMAL HEALTH

Day 13

10. PROBLEM AREA: Occupational Roles of the Veterinarian, Farmer and Other Animal Health Workers

Objectives:

To develop an understanding of:

a. The occupational roles for veterinarians, farmers, and other animal health workers
b. Opportunities for employment in the field of animal health

To develop an ability to care for sick animals

References:

a. Animal Health, Ch. 12, pp. 81-87
b. Animal Health Handbook, pp. 36-38

Day 14

11. PROBLEM AREA: Summary and review

Objectives:

To review previously covered material and answer student questions

References:

a. All previous assignments

COMMERCIAL FERTILIZERS

COMMERCIAL FERTILIZERS

Problem Area Outline by Days

Day	
1	Influence of Fertilizers on Farming
2 & 3	Essential Plant Food Elements and Their Function in Plant Growth
4	Hunger Signs of Crops
5 & 6	Taking a Soil Sample
7	Liming to Correct Soil Acidity
8 & 9	Understanding the Soil Test Report
10	Determining the Amount of Nutrients Available in the Soil
11	Determining Fertilizer Application Rates
12 & 13	Selecting Fertilizer Materials to Fill Nutrient Needs
14	Summary and Review
15	Post-Test

COMMERCIAL FERTILIZERS

Behavioral Objectives: (understandings and abilities)

Understanding of:
1) The influence of fertilizers on farming
2) The essential plant food elements and their function in plant growth
3) The effect of soil acidity on crop production

Ability to:
1) Recognize hunger signs of crops
2) Take a soil sample
3) Correct soil acidity by liming
4) Interpret the soil test report
5) Determine the amount of nutrients available in the soil
6) Determine fertilizer application rates
7) Select fertilizer materials to fulfill nutrient needs

COMMERCIAL FERTILIZERS

Day 1

1. PROBLEM AREA: Influence of Fertilizers on Farming

Objectives:

To develop an understanding of:

a. The benefits to be gained from fertilizing
b. The increase in fertilizer use in Iowa and the local community
c. The need to maintain soil fertility
d. How plant food is lost

References:

a. Our Land and Its Care, pp. 2-21, 62-65, 67-68
b. Fertilizer Use in Iowa Reaches Record Level, Iowa Farm Service Publication No. 1231

Days 2 and 3

2. PROBLEM AREA: Essential Plant Food Elements and Their Function in Plant Growth

Objectives:

To develop an understanding of:

a. The essential plant food elements and their function in plant growth
   (1) Primary nutrients and their function in plant growth
      (a) The function of nitrogen in plant growth
      (b) The function of phosporus in plant growth
      (c) The function of potassium in plant growth
   (2) Secondary plant nutrients and their function in plant growth
      (a) The function of calcium in plant growth
      (b) The function of magnesium in plant growth
      (c) The function of sulfur in plant growth
   (3) Micro plant nutrients and their function in plant growth

References:

a. Our Land and Its Care, pp. 23, 26-34
b. Growth and Nutrient Uptake by Corn, Pamphlet 277

Day 4

3. PROBLEM AREA: Hunger Signs of Crops

Objectives:

To develop an understanding of nutrient requirements of various crops

To develop an ability to:

a. Recognize primary plant food deficiencies
b. Recognize secondary plant food deficinecies
c. Recognize micro plant food deficiencies

References:

a. Our Land and Its Care, pp. 36-39
b. Be Your Own Corn Doctor -- NPK Bulletin

Days 5 and 6

4. PROBLEM AREA: Taking a Soil Sample

Objectives:

To develop an understanding of:

a. The effect of soil types on soil fertility
b. The effect of cropping sequence on soil fertility
c. Where soil samples may be analyzed

To develop an ability to:

a. Take a uniform and representative soil sample
b. Correctly fill out the soil and cropping information sheet

References:

a. How to take a Soil Sample, NPK Leaflet
b. Our Land and Its Care, p. 42
c. Soil and cropping Information Sheet, ST-8

Day 7

5. PROBLEM AREA: Liming to Correct Soil Acidity

Objectives:

To develop an understanding of:

a. What is soil acidity and how it is measured
b. The optimum pH range for farm crops
c. The effective calcium carbonate equivalent (ECCE) of various liming materials

To develop an ability to:

a. Correct soil acidity
b. Select proper liming materials
c. Determine proper liming rates

References:

a. Our Land and Its Care, pp. 18-19
b. Understanding Your Soil Test Report, Pamphlet 429, p. 5
c. Your Limestone Recommendation, (St-2)

Days 8 and 9

6. PROBLEM AREA: Understanding the Soil Test Report

Objectives:

To develop an understanding of:

a. What a soil test measures
b. How the amount of N, P, and K are determined by a soil test

To develop the ability to:

a. Select the correct soil test nutrient recommendation
b. Adjust soil test recommendations to specific crop yields

References:

a. Understanding Your Soil Test Report, Pamphlet 429, pp. 1-4
b. Soil Test Report, (ST-9)

COMMERCIAL FERTILIZERS

Day 10

7. PROBLEM AREA: Determining the Amount of Nutrients Available in the Soil

Objectives:

To develop the ability to estimate:

a. The nitrogen credits for 1st or 2nd corn following a legume
b. The amount of carryover available from fertilizer applied the previous year
c. The amount of nutrients supplied from manure that has been applied since soil was sampled

References:

a. Understanding Your Soil Test Report, Pamphlet 429, pp. 1-4
b. Modern Farmers Need to be Accountants in the Cornfield, Iowa Farm Service Publication No. 1049

Day 11

8. PROBLEM AREA: Determining Fertilizer Application Rates

Objectives:

To develop an understanding of the factors that affect fertilizer application rates:

a. Nutrient requirements from soil test report
b. Nutrients available in the soil

To develop the ability to:

a. Calculate proper fertilizer application rates
b. Convert P_2O_5 to Phosphorous
c. Convert K_2O to Potassium

References:

a. Understanding Your Soil Test Report, Pamphlet 429, pp. 2-4
b. Better Names for "Phosphate" and "Potash", Iowa Farm Service Publication No. 1050

Days 12 and 13

9. PROBLEM AREA: Selecting Fertilizer Materials to Fill Nutrient Needs

Objectives:

To develop an understanding of the major sources of fertilizer materials available in the community

To develop the ability to:

a. Change nutrient recommendations into amounts of a fertilizer grade
b. Select fertilizer materials that will fulfill nutrient needs

References:

a. Understanding Your Soil Test Report, Pamphlet 429, pp. 5-6
b. Our Land and Its Care, pp. 44-45, 56, 57

Day 14

10. PROBLEM AREA: Review and Summary

Objectives:

To review previous material covered in this partial unit

References:

a. Those cited for each of the problem areas studied

SMALL GASOLINE ENGINES

SMALL GASOLINE ENGINES

Problem Area Outline by Days

Day	
1	Engine Principles - Two and Four-cycle Engines
2	Nomenclature - Compression Factors
3	Valves
4	Valve Timing - Camshafts
5	Rings
6	Measuring Devies
7	Carburetion
8	Carburetor Types
9	Carburetor Adjustment - Governors
10	Air Cleaners
11	Ignition Systems
12	Magneto Cycle
13	Preventative Maintenance
14	Trouble Shooting - Review
15	Post-Test

SMALL GASOLINE ENGINES

Behavioral Objectives: (understanding and abilities)

Understanding of:
1) Basic principles of small engine operation
2) Difference between two and four-stroke cycle engines
3) Function of piston, rings, crankshaft, camshaft, and valves as related to compression
4) Fuction of carburetor and component parts
5) Function of small engine ignition systems and component parts
6) Measuring devices used on small engines

Ability to:
1) Identify basic small engine components
2) Perform general maintenance on a small gasoline engine
3) Trouble shoot a small gasoline engine
4) Use various measuring and testing devices
5) Use a service manual

SMALL GASOLINE ENGINES

Day 1

1. PROBLEM AREA: Engine principles - Two and Four-Cycle Engines

Objectives:

To develop an understanding of:

a. The intake stroke, compression stroke, power stroke and exhaust stroke in an engine
b. The principles of operation of a two and four-cycle engine

References:

a. General Theories of Operation, Briggs & Stratton, Corp., pp. 2-3
b. Small Gasoline Engines Student Handbook, Penn. State Univ. pp. 1-3

Day 2

2. PROBLEM AREA: Nomenclature - Compression Factors

Objectives:

To develop an understanding of piston displacement and compression ratio as related to horsepower in a small engine

To develop an ability to:

a. Identify main parts of small engines
b. Calculate piston displacement and compression ratio

References:

a. General Theories of Operation, Briggs & Stratton, lorp., p. 4
b. Small Gasoline Engines Student Handbook, Penn. State Univ. p. 4

SMALL GASOLINE ENGINES

Days 3 and 4

3. PROBLEM AREA: Valves, Valve Timing and Camshafts

Objectives:

To develop an understanding of:

a. Valve operating conditions
b. Valve failures

To develop an ability to:

a. Identify parts of valve train
b. Determine usable valve margin and valve seat tolerances

References:

a. General Theories of Operation, Briggs & Stratton, Corp., pp. 4-7
b. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 5-7

Day 5

4. PROBLEM AREA: Ring Adjustment

Objectives:

To develop an understanding of:

a. The purpose of rings
b. Ring types and each's function

To develop an ability to:

a. Measure various ring clearances
b. Identify types of rings

References:

a. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 8-11

SMALL GASOLINE ENGINES

Day 6

5. PROBLEM AREA: Measuring Devices

Objectives:

To develop an understanding of various measuring devices

To develop an ability to read micrometer and other measuring devices

References:

a. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 12-19

Days 7, 8, and 9

6. PROBLEM AREA: Carburetion, Carburetor Types and Adjustment, and Governors

Objectives:

To develop an understanding of:

a. Principles of operation of carburetors
b. How gaseous mixture is controlled within the carburetor
c. Governor types and operation

To develop an ability to:

a. Identify basic parts of the carburetor
b. Explain operation of various types of carburetors
c. Governor types and operation

References:

a. General Theories of Operation, Briggs & Stratton, Corp., pp 8-13, 20-21
b. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 27-37

SMALL GASOLINE ENGINES

Day 10

7. PROBLEM AREA: Air Cleaners

Objectives:

To develop an understanding of:

a. The importance of an air cleaner
b. The different types and principles of operations of air cleaners

To develop an ability to service various types of air cleaners

References:

a. General Theories of Operation, Briggs & Stratton, Corp., p. 14
b. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 37-39

Days 11 and 12

8. PROBLEM AREA: Ignition and the Magneto Cycle

Objectives:

To develop an understanding of:

a. The purpose of ignition systems

b. Principles of magneto-ignition systems
c. A complete magneto cycle

To develop an ability to:

a. Identify parts of magneto-ignition system

References:

a. General Theories of Operation, Briggs & Stratton, Corp., pp. 15-18
b. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 45-51

SMALL GASOLINE ENGINES

Day 13

9. PROBLEM AREA: Preventative Maintenance

Objectives:

To develop an understanding of:

a. The importance of maintenance on small gasoline engines
b. Why clean, fresh, regular gasoline should be used in small gasoline engines

To develop an ability to:

a. Determine and analyze engine problem by observation of spark plug
b. Properly service engine at proper time (spark plugs, breaker points, air cleaners and oil)
c. Properly prepare small gasoline engine for storage
d. Follow a service and maintenance schedule

Reference:

a. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 55-59

Day 14

10. PROBLEM AREA: Trouble Shooting and Review

Objectives:

To develop an understanding of procedures used in trouble shooting

To develop an ability to trouble shoot an engine

Reference:

a. Small Gasoline Engines Student Handbook, Penn. State Univ., pp. 64-65

FARM CREDIT

FARM CREDIT

Problem Area Outline by Days

Day	
1	Introduction to Credit, "Problem"
2	"Problem", Application for Loan (Financial Statement)
3	Budgeting Principles
4	Budgeting the Problem
5	Budgeting, Complete Application for Loan
6	Types of Loans
7	Sources of Credit - Short Term & Intermediate
8	Sources of Credit - Long Term - (Land)
9	Interest Rates and Loan Costs
10	Collateral - Short and Intermediate Term
11	Collateral - Long Term
12	Credit Instruments - Short Term - Intermediate
13	Credit Instruments - Long Term - (Land)
14	Summary and Review
15	Post-Test

FARM CREDIT

Behavioral Objectives: (understandings and abilities)

Understanding of:

1) The importance of credit in agriculture
2) Types of credit used for specific purposes
3) The sources of credit
4) Interest rates and loan costs
5) Credit instruments
6) The criteria used in granting farm credit
7) The criteria used to evaluate a credit source
8) The career potentials in farm credit

Ability to:

1) Use credit to increase farm income
2) Budget income and expenses to determine credit needs
3) Select correct credit source based on financial position and needs
4) Calculate the cost of various types of loans
5) Use credit instruments
6) Prepare a financial statement
7) Plan a repayment schedule

FARM CREDIT

Days 1 and 2

1. PROBLEM AREA: The Problem

Objectives:

To develop an understanding of the need for credit

To develop an ability to:

a. Analyze a farming situation and determine the financial position of the applicant
b. Prepare a financial statement

References and Materials:

a. Financing Farm & Ranch Activities, pp. 8-11, 15
b. The Problem
c. Financial statement form

Days 3, 4, & 5

2. PROBLEM AREA: Budgeting

Objectives:

To develop an understanding of budgeting principles

To develop an ability to budget a farm credit problem

References and Materials:

a. Financing Farm & Ranch Activities, pp. 34, 36-37
b. The Problem
c. Budget Worksheet
d. Application for loan

FARM CREDIT

Day 6

3. PROBLEM AREA: Types of Loans (based on length of loan in years)

Objectives:

To develop an understanding of:

a. The three types of loans normally available
b. Disadvantages and advantages of various types of credit

To develop an ability to classify credit requirements into loan types

References and Materials:

a. Financing Farm & Ranch Activities, pp. 12-13

Days 7 & 8

4. PROBLEM AREA: Sources of Credit

Objectives:

To develop an understanding of:

a. The sources of credit
b. An understanding of the criteria used to evaluate a credit source

To develop an ability to determine the type of credit source to use

References and Materials:

a. Financing Farm & Ranch Activities, pp. 32-41, 50-66

FARM CREDIT

Day 9

5. PROBLEM AREA: Interest Rates and Loan Costs

Objectives:

To develop an ability to calculate the costs of various types of loans

References and Materials:

a. Financing Farm & Ranch Activities, pp. 18-19, 47-50

Days 10 & 11

6. PROBLEM AREA: Collateral

Objectives:

To develop an understanding of the criteria used in granting farm credit

To develop an ability to determine loan value of different types of collateral

References and Materials:

a. Financing Farm & Ranch Activities, pp. 14-17, 44-47

FARM CREDIT

Days 12 and 13

7. PROBLEM AREA: Credit Instruments

Objectives:

To develop an understanding of the types of credit instruments

To develop an ability to use credit instruments

References and Materials:

a. Financing Farm & Ranch Activities, pp. 19-29, 35-39
b. Blank credit instrument forms

Day 14

8. PROBLEM AREA: Summary

Objectives:

To develop an understanding of the career potentials in farm credit work

To review previous problem area objectives

References and Materials:

a. Financing Farm & Ranch Activities
b. The Problem
c. Budget Worksheet
d. Application for loan
e. Credit instruments

APPENDIX B: LIST OF FIELD TRIPS AND WORKSHEETS

LIST OF FIELD TRIPS

Day	Animal Health Field Trips:
2	Factors in maintaining animal health
5	Life cycles, symptoms, prevention and control of cattle parasites
10	Prevention and control of cattle parasites
12	Planning a general livestock health program

Day	Commercial Fertilizers Field Trips:
1	Influence of fertilizer on farming
6	Taking a soil sample
8	Obtaining the cropping history
11	Determining fertilizer application rates

Day	Small Gasoline Engines Field Trips:
1	Two- and four-cycle engines
6	Measuring devices
9	Carburetion and governor
12	Ignition and magneto cycle

Day	Farm Credit Field Trips:
2	The problem
6	Types of loans
8	Sources of credit
11	Collateral

CHECKLIST FOR DETERMINING ANIMAL HEALTH AND CONDITIONS

Name_____

Place a check in the appropriate box or boxes.

1. Posture or Stance

[ ] abnormal posture
[ ] stands erect
[ ] unusually quiet
[ ] calm disposition
[ ] unusually restless
[ ] _____
[ ] _____

2. Movement

[ ] stiffness
[ ] lameness
[ ] moves about easily
[ ] walks in circles
[ ] holds head erect
[ ] hooves need trimming
[ ] hooves normal
[ ] hooves too short
[ ] _____
[ ] _____

3. Voice

[ ] loud and noisy
[ ] excited
[ ] pleasant and pleasing
[ ] low and gruff
[ ] _____
[ ] _____

4. Skin and Coat

[ ] coat smooth and glossy
[ ] hide pliable and loose
[ ] heavy hair coat
[ ] patchiness of hair coat
[ ] abnormal sweating
[ ] small sores
[ ] excessive itching and rubbing
[ ] representative hair color
[ ] abnormal hair color
[ ] _____
[ ] _____

5. Appetite

[ ] eats excessively
[ ] eats regularly
[ ] seldom eats
[ ] overly fat
[ ] good body condition
[ ] poor body condition
[ ] _____
[ ] _____

6. Mucous Membranes

[ ] pale color
[ ] dark red color
[ ] yellowish color
[ ] pinkish color
[ ] no unusual odor
[ ] unusual odors
[ ] moist
[ ] dry
[ ] _____
[ ] _____

7. Intestinal Discharges

[ ] diarrhea
[ ] normal consistency of feces
[ ] feces too dry
[ ] blood in feces
[ ] parasites in feces
[ ] _____
[ ] _____

8. Condition of Equipment and Facilities

[ ] lots wet and dirty
[ ] lots dry and clean
[ ] clean feeding conditions
[ ] dirty feeding conditions
[ ] comfortable housing
[ ] inadequate housing
[ ] equipment in poor condition
[ ] equipment in good condition
[ ] facilities in poor condition
[ ] facilities in good condition
[ ] good manure disposal
[ ] poor manure disposal
[ ] _____
[ ] _____

General Conclusions: On the back of this page please write what you feel the general health condition of these animals are. Also include a brief statement on the overall conditions of the buildings and equipment and their effect on animal health.

CATTLE PARASITES

Name_____

Parasite	Type	Life Cycle	Symptoms	Prevention	Control
Screw Worms					
Grubs					
Flies					
Stomach Worms					
Lice					

ANIMAL HEALTH

Name_____

Disease	Type	Cause	Symptoms	Prevention and Control	Treatment
Cholera					
Erysipelas					
Chronic Mycoplasmal Pneumonia					
Atrophic Rhinitis					
Brucellosis					

Disease	Type	Cause	Symptoms	Prevention and Control	Treatment
Flu					
TGE					
Leptospirosis					
MMA					

PLANNING THE GENERAL LIVESTOCK HEALTH PROGRAM

Name_____

1. What type of housing and ventilation is provided?

2. How does he clean the housing?

3. What is done with the manure?

4. Does he rotate his livestock pastures? If so, how?

5. Are the feeders and waterers clean?

6. How are undesirable birds and rodents controlled?

7. What is done with newly purchased animals?

8. How are visitors accommodated in the livestock area?

9. What is done with dead animals?

10. What diseases are vaccinated for?

11. How are parasites controlled?

12. How are open wounds and sores treated?

COMMERCIAL FERTILIZERS

Name_____

1. What benefits has the farmer gained from using fertilizer on his farm?

2. In 1966 Iowa used 22 percent more fertilizer than in 1965, and this was 2 1/2 times the amount used in 1960. How much has he increased his use of fertilizer since 1960?

3. How have his crop yields increased since 1960?

4. How is plant food lost on this man's farm?

5. How does his cost of fertilizer today compare with 1960?

6. Why does he think we need to maintain soil fertility?

— PLEASE PRINT

SOIL AND CROPPING INFORMATION SHEET

IOWA STATE UNIVERSITY of Science and Technology
COOPERATIVE EXTENSION SERVICE
AMES, IOWA . . . September 1968 . . . ST-8

Your Name_____

Street/ RFD_____

Town_____

State_____ Zip Code_____

Date_____

CHECK BELOW IF COPIES ARE TO BE SENT TO:

_____ County ASC

_____ County Extension

Send Extra Copy To_____

Street/ RFD_____

Town_____

State_____ Zip Code_____

FOR ESTABLISHED CHARGE ACCOUNTS ONLY:

_____ Charge_____ County Extension

_____ Charge_____ County ASC Office

_____ Charge_____
(NAME OF COMPANY)

— FOR LAB USE ONLY —

FILL IN AS COMPLETELY AS POSSIBLE

SAMPLE IDENTIFICATION			SOIL DESCRIPTION					DEPTH OF PLOWING (INCHES)	PREVIOUS TREATMENTS					
									APPLIED LAST YEAR				LIMESTONE	
									FERTILIZER (lbs./A) of					
LAB NO. - DO NOT USE -	SAMPLE NO. ON BAG	ACRES	SOIL TYPE	PERCENT SLOPE (Estimated)	DRAINAGE G - GOOD F - FAIR P - POOR	BOTTOM OR UPLAND	DEPTH OF TOPSOIL (INCHES)		N	P_2O_5	K_2O	MANURE TONS/A	YEAR APPLIED	ECCE lbs./A

162

CROP HISTORY FOR ABOVE SAMPLES

NO. ON BAG	LIST CROPS IN ORDER OF SEQUENCE								REMARKS: (Note any special conditions of the soil or crops)
	3 YEARS AGO 19____	YIELD	2 YEARS AGO 19____	YIELD	LAST YEAR 19____	YIELD	CROP TO BE FERTILIZED	CROP ONE YEAR LATER	

FARM LOCATION_____

County_____ Twp. No._____ Circle One NE SE SW NW

Range No._____ Section No._____ Quarter Section

Draw map showing location of buildings, streams, field boundaries, etc., relative to areas sampled.

— DO NOT REMOVE CARBONS —
Send Original and all 3 copies to:

SOIL TESTING LABORATORY
IOWA STATE UNIVERSITY
AMES, IOWA 50010

Cooperative Extension Service, Iowa State University of Science and Technology and the United States Department of Agriculture cooperating. Marvin A. Anderson, director, Ames, Iowa. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.

FIELD RECORD

FIELD NO.....

ACRES.....

	19.....	19.....	19.....
1. Crop.....	_____*	_____*	_____*
a. Name of hybrid or variety.....	_____	_____	_____
b. Planting date.....	_____	_____	_____
c. Planting rate (acres per bushel).....	_____	_____	_____
d. Yield per acre.....	_____	_____	_____

2. Fertility Applied Per Acre	Analysis	Pounds	Date	Analysis	Pounds	Date	Analysis	Pounds	Date
a. Fertilizer									
Row.....									
Broadcast.....									
Additional N.....									
b. Tons of Manure.....									

3. Other Practices	Kind	Rate	Date	Kind	Rate	Date	Kind	Rate	Date
a. Insecticide.....									
b. Herbicide.....									

4. Lime Applications Per Acre	ECCE	Pounds	ECCE	Pounds	ECCE	Pounds
a. Plowdown.....						
b. Applied on surface.....						

5. Notes: (kind of season, etc.)

---

*Indicate current crop such as corn, oats, soybeans, etc.

RETEST SOIL EVERY 3 YEARS

DETERMINING FERTILIZER APPLICATION RATES

Name_____

1. What are the type of fertilizer analysis that the fertilizer dealer handles?

2. Which of the following types of fertilizer does he handle?

   [ ] liquid.
   [ ] dry.
   [ ] gaseous.

3. What is the current price of fertilizer?

4. What is the cost of custom application?

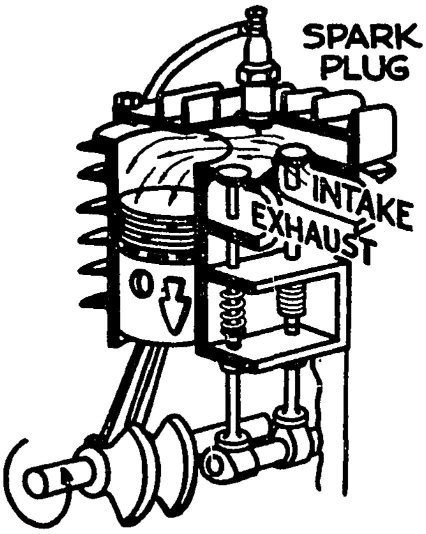
5. How does the fertilizer dealer convert P_2O_5 to Phosphorus?

6. How does the fertilizer dealer convert K_2O to Potassium?

7. How does the fertilizer dealer figure proper fertilizer application rates for a farmer?

Name________________________

Fill in the blanks and place a check in the appropriate boxes.

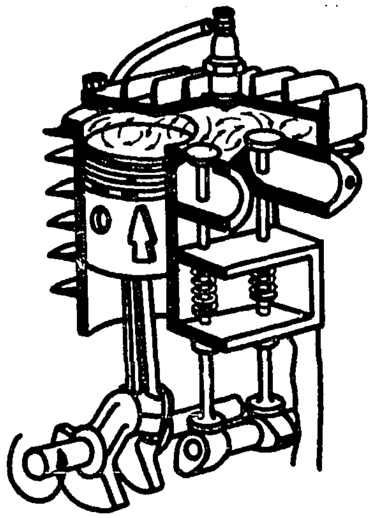


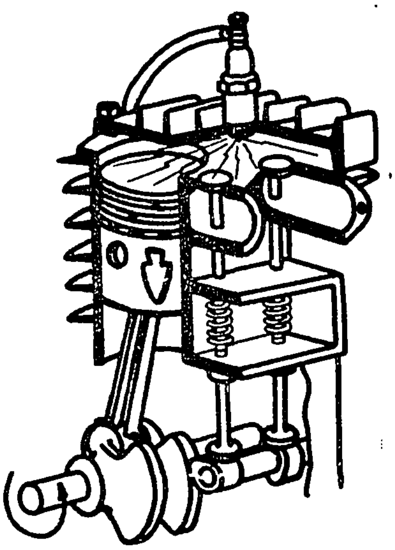
______________ Stroke

[ ] Intake valve open
[ ] Intake valve closed
[ ] Exhaust valve open
[ ] Exhaust valve closed
[ ] Piston moving up
[ ] Piston moving down
[ ] Spark occurs
[ ] No spark

______________ Stroke

[ ] Intake valve open
[ ] Intake valve closed
[ ] Exhaust valve open
[ ] Exhaust valve closed
[ ] Piston moving up
[ ] Piston moving down
[ ] Spark occurs
[ ] No spark



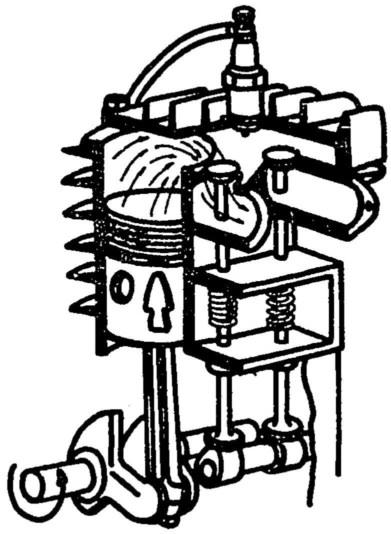


______________ Stroke

[ ] Intake valve open
[ ] Intake valve closed
[ ] Exhaust valve open
[ ] Exhaust valve closed
[ ] Piston moving up
[ ] Piston moving down
[ ] Spark occurs
[ ] No spark

______________ Stroke

[ ] Intake valve open
[ ] Intake valve closed
[ ] Exhaust valve open
[ ] Exhaust valve closed
[ ] Piston moving up
[ ] Piston moving down
[ ] Spark occurs
[ ] No spark



Number of strokes per cycle
[ ] 1
[ ] 2
[ ] 3
[ ] 4

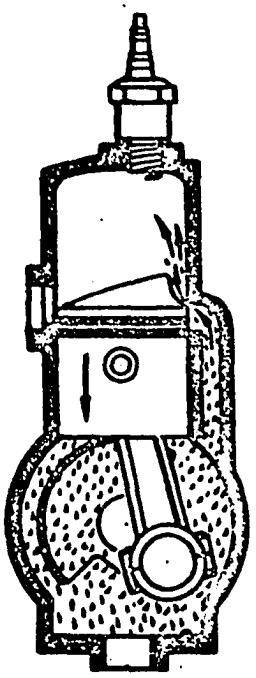
Number of crankshaft revolutions per cycle
[ ] 1
[ ] 2
[ ] 3
[ ] 4

TWO-CYCLE ENGINE OPERATION

166

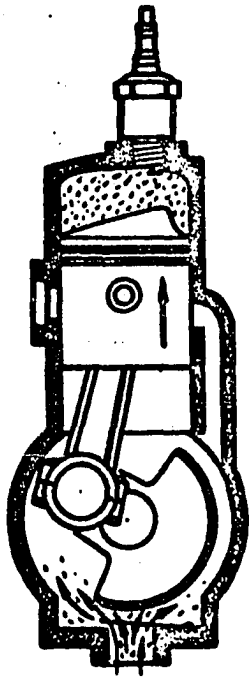
Name_____

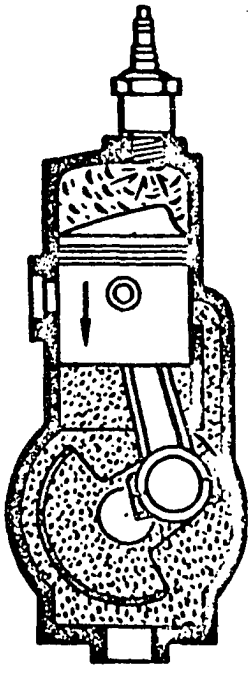
Fill in the blanks and place a check in the appropriate boxes.



_____ Stroke

[ ] Intake port uncovered first
[ ] Intake port uncovered second
[ ] Exhaust port uncovered first
[ ] Exhaust port uncovered second
[ ] Piston moving down
[ ] Piston moving up
[ ] Spark
[ ] No Spark
[ ] Reed valve open
[ ] Reed valve closed
[ ] Fuel enters crankcase
[ ] Fuel compressed in crankcase
[ ] Fuel ignited in cylinder
[ ] Fuel compressed in cylinder





_____ Stroke

[ ] Intake port uncovered first
[ ] Intake port uncovered second
[ ] Exhaust port uncovered first
[ ] Exhaust port uncovered second
[ ] Piston moving down
[ ] Piston moving up
[ ] Spark
[ ] No spark
[ ] Reed valve open
[ ] Reed valve closed
[ ] Fuel enters crankcase
[ ] Fuel compressed in crankcase
[ ] Fuel ignited in cylinder
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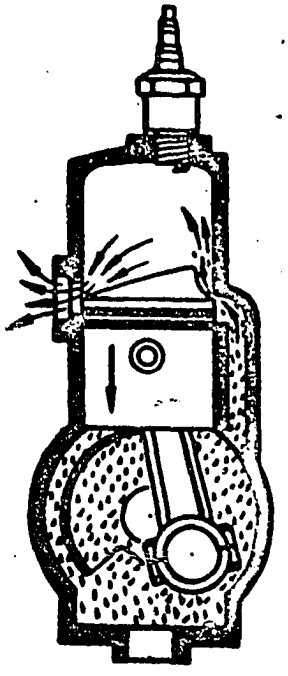


Number of strokes per cycle

[ ] 1
[ ] 2
[ ] 3
[ ] 4

Number of crankshaft revolutions per cycle

[ ] 1
[ ] 2
[ ] 3
[ ] 4

MEASUREMENT DEVICES

Name_____

1. What are the common kinds of micrometers?

   a. _____
   b. _____
   c. _____

2. Micrometers are usually designed to measure within a _____ inch(es) range.

3. List the ranges that the following sizes of micrometer can measure:

Size	Range of Measurement
1"	_____
2"	_____
3"	_____

4. What is the cost of the following micrometers?

Size	Cost
1"	_____
2"	_____
3"	_____
0-6"	_____

5. The micrometer screw has _____ threads to an inch.

6. Each mark on the thimble is equal to _____ inch(es).

7. One complete revolution of the thimble is equal to _____ of an inch on the sleeve.

8. Each mark on the sleeve of the micrometer is equal to _____ inch(es).

9. What are three uses of the feeler gauge in servicing small gasoline engines?

   a. _____
   b. _____
   c. _____

10. The round wire gauge is used to measure _____ in servicing small gasoline engines.

11. The plasti-gauge used to measure the _____ when servicing small gasoline engines.

CARBURETOR AND GOVERNOR

Name_____

Fill out this form according to the type of motor that you are shown on this field trip.

1. Type of carburetor: _____

2. Where are the following principles and forces used in the carburetion system?

   a. atmospheric pressure

   b. venturi

   c. airfoil

3. What is the main function of the throttle?

4. What is the main function of the choke?

5. Briefly explain the correct procedure for adjusting the needle valve.

6. Briefly explain the correct procedure for adjusting the idle valve.

7. Briefly explain how this carburetor works.

8. Type of governor: _____

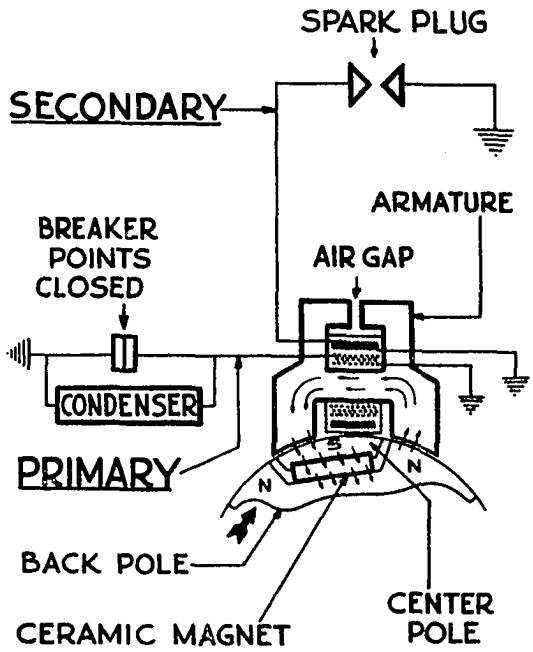
9. Briefly explain how this governor works.

IGNITION-1

Name_____

___1. The magnetic field is provided by the:

a. flywheel.
b. magnet.
c. armature.
d. coil.



___2. When the magnet is located away from the coil it:

a. does have an effect upon the coil.
b. does not have an effect upon the coil.
c. current flows in the armature.
d. current does not flow in the armature.

___3. As the magnet, located in the flywheel, approaches the coil, the line of force in the magnetic field are first cut by the:

a. primary winding of the coil.
b. secondary winding of the coil.
c. armature.
d. condenser.

___4. When the magnetic lines of force are cut by the windings, as noted in question 3, current begins to flow in:

a. the primary winding only.
b. the secondary winding only.
c. both the primary and secondary windings.
d. the condenser.

___5. While the breaker points are closed, the current produced in the primary windings:

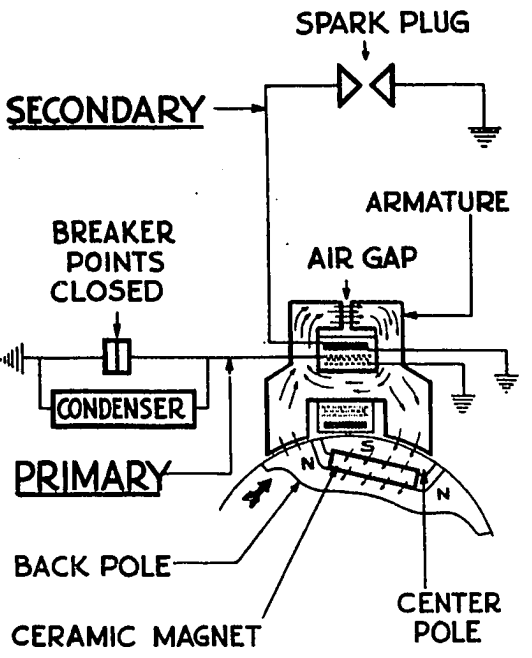
a. flows through the breaker points and completes the circuit through the ground.
b. is induced into the secondary circuit.
c. is absorbed by the condenser.
d. causes the spark to jump the spark plug gap.

___6. When the magnet first approaches the coil, the magnetic field is not established in the upper part of the core because the:

a. resistance of the core is too high.
b. air gap causes a resistance.
c. breaker points are closed.
d. voltage is too high.

IGNITION-2

Name_____



___1. When the flywheel magnet is opposite of the coil, the magnetic field is:

a. strongest in the primary windings.
b. strongest in the secondary windings.
c. at its highest peak in both primary and secondary windings.
d. beginning its buildup in the condenser.

___2. At this point, the piston is:

a. at top dead center.
b. at bottom dead center.
c. approaching bottom dead center.
d. approaching top dead center.

___3. At this point, the air gap sets up little resistance to flow in the secondary windings because the:

a. magnitism in the primary winding is at its highest peak.
b. breaker points are open.
c. condenser is fully charged.
d. voltage in the secondary winding is at its highest peak.

___4. Voltage is beginning to build up in the secondary circuit; however, we do not get a spark at the spark plug gap because the:

a. condenser is not fully charged.
b. gap of the spark plug resists flow in the secondary circuit.
c. air gap is too wide.
d. breaker points are open.

___5. To keep the spark plug from firing prematurely, the gap is normally set at:

a. .015 of an inch.
b. .025 of an inch.
c. .035 of an inch.
d. .045 of an inch.

___6. At this time the condenser is:

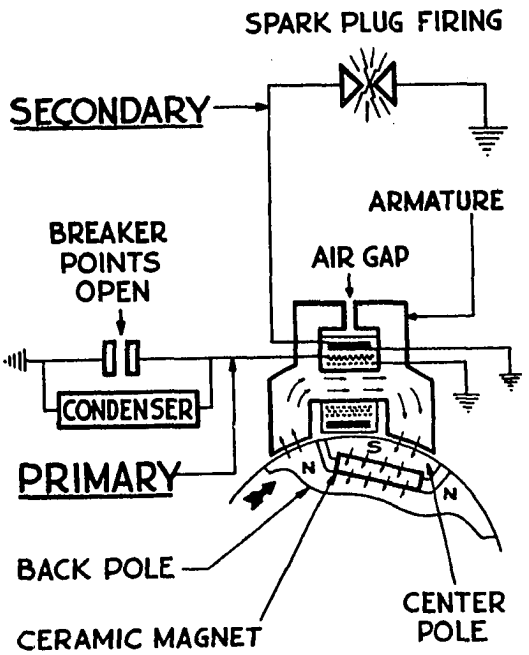
a. fully charged.
b. not functioning because it is bypassed.
c. beginning to absorb excess current.
d. feeding current back into the primary circuit.

IGNITION-3

Name_____

___1. The magnetic field collapses because the:

a. breaker points open.
b. condenser discharges excess current.
c. spark occurred.
d. secondary circuit is broken.



___2. The function(s) of the condenser include(s):

a. absorbing the current in the primary winding, thus aiding in the collapse of the magnetic field.
b. preventing the current from jumping the breaker points which keeps the points from arcing.
c. provides current for the spark during the next revolution.
d. both a and b.

___3. The collapse of the magnetic field induces a voltage in the secondary winding of approximately:

a. 10 volts.
b. 200 volts.
c. 5,000 volts.
d. 12,000 volts.

___4. The ratio of windings of the secondary coil to windings in the primary coil of approximate:

a. 25 to 1.
b. 60 to 1.
c. 150 to 1.
d. 200 to 1.

___5. When the breaker points are opened by the crankshaft, as in most small engines, a spark is produced:

a. once every revolution of the crankshaft.
b. twice every revolution of the crankshaft.
c. once every two revolutions of the crankshaft.
d. once every four revolutions of the crankshaft.

___6. The breaker point gap is usually:

a. .010 of an inch.
b. .020 of an inch.
c. .030 of an inch.
d. .040 of an inch.

General Purpose, Feeder
Dairy, Breeder
PCA 436R (7-67)

APPLICATION FOR LOAN

172 PRODUCTION CREDIT ASSOCIATION

The undersigned applies for a loan and submits his financial statement and the following information.

_____ Age _____ Address _____ Zip No. _____
Applicant

_____ Age _____ Children at home: _____ Boys, Age _____ ; _____ Girls, Age _____
Wife

_____ Age _____ Address _____
Applicant

_____ Age _____ Children at home: _____ Boys, Age _____ ; _____ Girls, Age _____
Wife

Location of farm _____ miles _____ and _____ miles _____ from _____, described as _____

_____
Sec. Twp. Range County State

_____ I have lived on above farm _____ yrs.

I have lived in above county _____ yrs. Former address _____
Town County State

FINANCIAL STATEMENT AS OF _____ 19____

ASSETS

PERSONAL PROPERTY

_____ Steers 1's.....@ $_____ Per Head $_____
_____ Steers 2's.....@ $_____ Per Head $_____
_____ Heifers 1's.....@ $_____ Per Head $_____
_____ Heifers 2's.....@ $_____ Per Head $_____
_____ Cows - 3 to 7 yrs.....@ $_____ Per Head $_____
_____ Cows - Over 7 yrs.....@ $_____ Per Head $_____
_____ Calves (19).....@ $_____ Per Head $_____
_____ .....@ $_____ Per Head $_____
_____ Bulls.....@ $_____ Per Head $_____
_____ Ewes - 1 to 3 yrs.....@ $_____ Per Head $_____
_____ Ewes - 4 and 5 yrs....@ $_____ Per Head $_____
_____ Ewes - Old.....@ $_____ Per Head $_____
_____ Lambs.....@ $_____ Per Head $_____
_____ Bucks.....@ $_____ Per Head $_____
_____ Sows - Vac.....@ $_____ Per Head $_____
_____ Shoats - Vac.....@ $_____ Per Head $_____
_____ Pigs - Vac.....@ $_____ Per Head $_____
_____ Other Hogs - Vac.....@ $_____ Per Head $_____
_____ .....@ $_____ Per Head $_____
_____ .....@ $_____ Per Head $_____

TOTAL ..... $

_____ Bu.....@ $_____ Per Bu. $_____
_____ Bu.....@ $_____ Per Bu. $_____
_____ Bu.....@ $_____ Per Bu. $_____
_____ Tons Hay..... $_____
_____ $_____

Matured Crops in Field Not Harvested:
_____ Acres - Corn.....Est. Yield..... $_____
_____ Acres.....Est. Yield..... $_____
Cash in Bank $_____ Good Notes $_____ $_____
Machinery and Equipment..... $_____
ier Property..... $_____
$_____

TOTAL CURRENT ASSETS..... $

REAL ESTATE OWNED

_____ Acres in _____ County $_____
_____ Acres in _____ County $_____
_____ Acres in _____ County $_____

Other Real Estate:
_____ in _____ Co. State $_____

TOTAL VALUE FARM LAND..... $

TOTAL ASSETS..... $

LIABILITIES

CURRENT DEBTS

Chattel Mortgages Prop. Covered, Maturity, and Due Dates and Amounts on Installment Contracts.

_____ $_____
_____ $_____
_____ $_____
_____ $_____
_____ $_____
Notes to Banks (Unsecured)..... $_____
_____ $_____
Notes Endorsed for Others..... $_____
_____ $_____
Seed..... $_____
Fertilizer..... $_____
Implement Debts..... $_____
_____ $_____
Gas and Oil..... $_____
_____ $_____
Feed Accounts..... $_____
Leases and Cash Rent Past Due..... $_____
Amount Due Relatives..... $_____
Doctor and Hospital Bills..... $_____
Miscellaneous Accounts..... $_____
_____ $_____
_____ $_____

TOTAL..... $

Judgments (Explain in Separate Statement)..... $_____
Personal Taxes (Past Due)..... $_____
Real Estate Taxes (Past Due)..... $_____
Real Estate Loan Interest (Past Due)..... $_____

TOTAL CURRENT DEBTS..... $

ENCUMBRANCES ON REAL ESTATE

_____ acres F.L.B..... $_____
Instal. $_____ due _____ $_____
_____ $_____
_____ acres to others..... $_____
Instal. $_____ due _____ $_____
_____ $_____
_____ $_____
_____ $_____

TOTAL ENCUMBRANCES ON REAL ESTATE..... $

TOTAL LIABILITIES ..... $_____
NET WORTH ..... $_____

TOTAL ..... $

PURPOSE OF LOAN: Describe and Itemize

_____ $_____
_____ $_____
_____ $_____
_____ $_____
_____ $_____

Amount

_____ $_____
_____ $_____
_____ $_____
_____ $_____
Credit Life Insurance Yes ( ) No ( ) $_____

To be budgeted for operating expenses..... $_____

TOTAL ..... $_____

If tenant, give name and address of landlord _____

No. acres rented _____ Date lease expires _____ Total annual cash rent $ _____ When due _____

Share rent? _____ What arrangements have you made for renewal of your lease? _____

CROPS Growing, or to be grown on land I operate including those cultivated by others are: (Do not include matured crops and grain on hand in this schedule. Show such crops and grain in financial statement.)

CROPS	Total Acres	Yield Per Acre	My Share	Estimated Bushels Borrower's Share	CROPS	Total Acres	Yield Per Acre	My Share	Estimated Bushels Borrower's Share
					Hay				
					Pasture				

ESTIMATED OPERATING COSTS AND OTHER CASH OUTLAY:					TOTAL
Cash Rent $ _____ R.E. Payment $ _____ Int. $ _____					
Taxes: R.E. $ _____ Income $ _____ Personal $ _____					
Seed $ _____ Fertilizer $ _____ Chemical $ _____					
Feed _____					
Labor $ _____ Machine Hire $ _____					
Repairs $ _____ Gas and Oil $ _____					
Supplies and Vet. Expense _____					
Family (Living, fuel, car, etc.) _____					
Insurance: Life $ _____ Crop $ _____ Property $ _____					
Subtotal					
Livestock to be Purchased					
TOTAL					
CASH INCOME:					
UNPLEDGED:					
Poultry $ _____ Dairy $ _____					
Other _____					
PLEDGED: Repayment on Loan					
Itemize Sale Date					
TOTAL CASH INCOME					
BUDGET REQUESTED					
ADDITIONAL FINANCING TO BE CONSIDERED LATER					

If applicant is a woman, state how and when she acquired title to the property owned _____

whose name is the record title of real estate other than leased land? _____

When acquired? _____ Price paid _____ Original mtg. _____ Inherited _____

Is anyone else interested in your farming or livestock operations? _____

If so, state particulars _____

Do you live on farm and are you in actual possession of property offered? _____ If not, explain _____

Are any relatives or others of age living with you? _____

If so, explain _____

Is there any livestock on your place not owned by you? _____ If so, describe: give name of owner; explain how identified from security offered _____

What livestock is now or will be put on feed for market? _____

Have you, or any immediate member of your family, ever filed a petition in bankruptcy? _____

If so, explain fully _____ When discharged? _____

In consideration of approval of the loan, the undersigned authorizes issuance by the association of the necessary class B stock and investment in the Equity Reserve to support the loan. The undersigned further authorizes the association to pay out of the proceeds of the loan the amount required (1) for purchase of class B stock; (2) for investment in the Equity Reserve; (3) to pay all application, inspection, filing and abstracting fees and costs incident to the completion of this or additional loans; (4) to pay such other obligations owing by me as indicated in the schedule headed "Purpose of Loan" in this application. The undersigned certifies that _____ ha__ read the above application and fully understand__ the contents thereof and that each statement contained therein is true.

Do you desire Credit Life Insurance? _____

Social Security Number _____

Initial of person who assisted in filling out this application _____

Date _____ _____

_____
Signature of Applicant

_____
Signature of Applicant

_____
Signature of Applicant

FARM CREDIT

Name_____

Type of Credit	Uses	Length of Credit	Source of Credit	Advantages	Disadvantages
1. Short Term					
2. Intermediate Term					
3. Long Term					
4. Consumer or Installment Buying					
A. Charge Account					
B. Installment					
C. Personal Loans					

FARM CREDIT

Name_____

Sources of Credit	Type of Credit	Character	Lending Policies	Permanence and Dependability	Experience & Knowledge of Farming	Cost of Loan
Commercial Banks						
PCA						
FHA						
Individuals						
Merchants and Dealers						
Life Insurance Companies						
Federal Land Bank						

COLLATERAL

Name_____

1. What characteristics do you look for in a borrower?

2. How do you determine the loan value of the following items?

   a. car

   b. farm machinery

   c. livestock

   d. furniture

3. How do you determine how much to loan a man for farm operating expenses?

4. What procedure do you have applicants follow in applying for a loan?

5. How do you figure interest rates?