Experimental evaluation of single-concept films as instructional aids in teaching vocational agriculture

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EXPERIMENTAL EVALUATION OF SINGLE-CONCEPT FILMS AS INSTRUCTIONAL AIDS IN TEACHING VOCATIONAL AGRICULTURE

by

John Allen Klit

A Dissertation Submitted to the Graduate Faculty in Partial Fulfillment of The Requirements for the Degree of DOCTOR OF PHILOSOPHY

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INTRODUCTION

Providing effective classroom instruction has been one of the major problems which has plagued our educational system since teachers first entered the classroom. This has resulted in much instruction being centered toward passive students when it should be toward active learners. One way of approaching the problem has been the use of various instructional media to increase student motivation. Increased student motivation should enhance student interest and create an active learner with the final result being effective classroom instruction. This study was designed to determine the relationship of a new instructional media to improved classroom instruction in the specific curriculum area of high school vocational agriculture.

In our rapidly expanding and changing profession of education, new instructional media have constantly been invented which were designed to help solve the problems of classroom instruction. Whether or not these materials, devices, or equipment were valuable to vocational agriculture instructors in the state of Iowa, depended on the instructors. After they had been introduced to the new approach, they had to be willing to personally test it. They then had to be able to adapt it to teaching vocational agriculture. If those criterion were met, the new instructional media would be of use in the profession, and classroom instruction would improve.

One such development has been that of single-concept films. A single-concept film could be described as a short instructional film of not more than four minutes in length which focuses on individual segments or concepts of subject matter.
Motion pictures in the form of 16 millimeter films have been used in teaching for more than half a century. Use of these films has been limited by educators due to the cost and complexity of the equipment and the availability of films. The films were generally too long and only segments of the films pertained to subject matter that would be taught during a given class period. Another major limitation of 16 millimeter films has been that they tend to decrease instructor participation in the instructional program. The instructors are replaced by experts who narrate the professionally made movies. Problems arise when the instructors return to the classes after the films are shown. Since 16 millimeter films are developed to fit a wide viewing audience, they often lack a personal touch very much needed in classroom teaching.

To overcome the limitations of 16 millimeter films, technological developments in the late 1950's provided hardware which made the idea of single-concept films possible for classroom use. Eastman Kodak Company altered their regular line of 8 millimeter equipment to produce a film which had a larger frame on which pictures were imprinted. This meant that more light was forced through each frame producing a larger, brighter, clearer picture projected on the screen. The increase in size was sufficient to permit its use in classroom situations. The new innovation was appropriately called super 8 millimeter film production. Technicolor Corporation closely followed Eastman Kodak Company in producing a continuous film loop storage device called the magi-cartridge. They also produced a line of cartridge loading instant movie projectors to show the magi-cartridges. This greatly reduced the complexity faced by teachers wishing to show a movie. Technology has then provided educators with both a suitable class-
room film and a line of easy to operate projection equipment. The educa-
tors had to be willing to adapt the use of single-concept films to their
own classroom situations in order for the technique to be a successful in-
structional aid.

The purpose of this study was to experimentally evaluate the effec-
tiveness of single-concept films as instructional aids in teaching pre-
scribed subject matter to vocational agriculture students in Iowa high
schools. This purpose was restated in the form of two general objectives.
They were as follows:

1. To determine the effectiveness of single-concept films as an
   instructional aid in teaching vocational agriculture.
2. To determine selected interest and ability characteristics of
   students who achieve best with the aid of single-concept
   films.

The use of single-concept films was further narrowed in this study.
They were not designed to be used for individual instruction by the stu-
dents. They were instead designed to be used by the instructor in his
classroom during the class period. No audio portion was provided on tape
with these films. The instructors narrated the films as they used them in
their classroom presentations. The theory being that the addition of an-
other sense (sight) to that of hearing would enhance student learning. The
single-concept films were used no differently than had other instructional
aids such as chalkboards and overhead projectors with which the instructors
were already familiar. The differences were that motion, picture detail,
and color were added to the thoughts which the instructor was conveying.

There are several advantages of single-concept films over other forms
of media. These films are short and to the point. They are no longer than four minutes in length. If the instructor feels that the message conveyed in the film is not being comprehended, the film can be shown over and over again until the instructor is satisfied that learning has occurred. This is possible due to the continuous loop concept which permits the beginning of the film to immediately follow the end of the film.

Another advantage is that the instructor is not removed from the class presentation. He remains before the class and handles the entire lesson with the aid of the film. A fourth advantage has been the reasonable cost of the films, the projection equipment, and the equipment necessary for teachers to make their own films. If the classroom teacher produces his own films, a fifth advantage could be added. Personalized films involving the local situation would greatly enhance student learning.

No one should be more qualified to produce single-concept films for a course than the teacher of that class. The instructor is most familiar with the subject matter, he knows the course better than anyone else, he knows the problem areas, and no one understands the students in a particular classroom better than the instructor.

It has been extremely difficult for vocational agriculture instructors to find suitable commercially made single-concept films related to agriculture subjects. In other subject matter areas, such as the physical sciences, large numbers of commercial films have been produced. The problem of availability of films for this study was solved by producing 21 films related to the prescribed subject matter to be used by the instructors in their teaching. Through this process, the use of single-concept films was then introduced to the classrooms of the vocational agriculture instructors
involved in this study. The effectiveness of this instructional aid was then evaluated in terms of the capabilities of single-concept films under the specific conditions in which they were used.

This study was a part of a larger project which investigated, experimentally, the effectiveness of selected resources and techniques on instruction in vocational agriculture. The project was conducted 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 Research Coordinating Unit. A research grant was obtained from the Iowa Department of Public Instruction, Division of Vocational Education from Ancillary Funds provided by the Vocational Education Act of 1963.
Finding suitable review material for this study was difficult. Considerable work has been published on how to make single-concept films and discussing their projected role in tomorrow's education. Very little work was found on actual experiments using single-concept films in teaching. The first part of the review of literature chapter is devoted to a discussion of single-concept films, their potential in education, and production techniques. Those studies experimentally utilizing 16 millimeter educational films and single-concept films are reviewed in the second and third sections of the chapter.

Trends in the Development and Use of Single-Concept Films

Single-concept films were defined by Anderson (1) to be short (almost always less than four minutes) and focus only on individual segments of subject matter. This could be compared to the traditional educational motion pictures which tend to be self-sufficient and complete in their presentation.

The development and use of single-concept films should not be called a new innovation. Wagner (24) pointed out that one producer developed some six hundred such films in the late 1920's. One vital element was lacking at this time to make it successful. This was projection equipment. The recent movement toward single-concept films has been largely due to technological innovations. The extraordinary utility of the new super 8 millimeter cartridge-loading projectors should be given most of the credit.

Anderson (1) supported the feeling that the recent enthusiasm for single-concept films has been due to the development of new technology.
The author (1, p. 28) stated that:

With the appearance of uncomplicated cartridge-loading 8 mm projectors and efficient systems for viewing in lighted rooms, motion pictures can be as easy to use as overhead projectors or chalkboards.

In another article, Anderson (2) indicated three other reasons why the use of single-concept film may not have established itself earlier than it did. These included:

1. The theatrical motion pictures probably determined the basic concept of a film as a complete, self-sufficient unit. This structural outlook was picked up by educational producers and continued through the years.

2. The longer educational films have had a record of success.

3. The elaborate production methods of many traditional format films were in most cases demanded by film makers who often times liked to think big and arty.

Kemp and Szumski (11) pointed out that in 1965 Eastman Kodak Company introduced a new 8 millimeter film format called super 8. The term standard 8 millimeter was then applied to the old format to differentiate the two. There were physical differences between the two film types which were both 8 millimeters in width. The authors indicated that super 8 had certain advantages over standard 8 millimeter. These include (1) an adequate area for a sound track alongside each frame and (2) a 50 percent larger picture area. This last advantage was especially important. Kemp and Szumski felt that because of the larger picture area, plus the increase in quality of present-day super 8 millimeter camera and projector lenses, and the increased light output of projection lamps, the projected image from
super 8 millimeter film was appreciably sharper and brighter than was comparable standard 8 millimeter projection. This meant that super 8 millimeter film could then be used satisfactorily for class and group viewing.

It was the hope of Forsdale (5) that 8 millimeter film would help bring motion pictures geographically closer to the potential user, and at the same time make the showing of films simple. One of these goals, according to him, was keyed to economics, the other to engineering. Both favor 8 millimeter and both work against 16 millimeter.

These points were further substantiated by Hemenway (10). He pointed out that it appears 8 millimeter film has been pulled out of the slump caused when super 8 millimeter was introduced. Super 8 millimeter now has become the standard 8 millimeter format. Regular 8 millimeter "has become a living fossil."

Happe (9) felt that the enthusiastic welcome given to equipment which permitted a moving picture to be presented in a classroom, and repeated as often as necessary, without any of the operational problems normally associated with the handling and threading of normal projectors, was a clear demonstration that this form of visual aid could meet a very real need of classroom instructors.

The potential of new developments in the super 8 millimeter film field was discussed by Miller (14). The new developments included sound, push-button loading, larger picture area, and cartridge packaging of films. The advantages which these developments provided the classroom teacher were accessibility, convenience, ease of operation, low cost, and improved picture and sound quality.

The author felt that the key advantage to the classroom teacher was
that of accessibility. The lightweight, portable, low-cost projectors and compact film packs that could be stored in each classroom would help eliminate requisition forms needed to order films and projectors in advance and eliminate the pick-up and delivery of films from film libraries or audiovisual materials centers. Miller went on to point out that the simplicity of the super 8 millimeter equipment also eliminates many problems that teachers previously faced in showing films.

It was contended by Olsen (17) that the textbook dominated American education. The use of 16 millimeter films has at best been only a supplementary tool and very secondary in importance. There were many reasons for this, not the least of which was that the use of 16 millimeter films presents problems in utilization. Such problems as limited choice of films, difficulty in acquisition of films, finding time to preview films, and in adjusting the instructional program to the use of films designed for large group instruction when the class involved was an indifferentiated unit.

These difficulties may be overcome by use of 8 millimeter films according to Olsen (17, p. 104). He stated that:

8 mm film has inherent characteristics that, unlike 16 mm films, make it possible for it to become a prime tool of educational instruction, rather than a supplementary aid.

The advantages seen by Olsen of 8 millimeter film as compared to the conventional 16 millimeter film were as follows:

1. Eight millimeter film can be enclosed in inexpensive plastic cartridges that makes it easy to store and keep clean.

2. The commercial cost of 8 millimeter color prints are very low in comparison to the cost of 16 millimeter film.

3. The 8 millimeter films have an educational value all of
their own. They can be used to develop single concepts, single skills; and to show demonstrations, illustrations, and stories related to these concepts.

4. Eight millimeter film promotes individualized instruction as compared to 16 millimeter film which promotes large group instruction.

Even though the 8 millimeter film seems to have merit, Olsen felt that it would probably be a mistake to believe that 8 millimeter film would be widely adopted by school systems very rapidly. The growth would instead be a gradual emergence of an 8 millimeter market of moderate dimensions. The reason for this was the traditional general lag in school's acceptance of innovations.

Discussion will now be directed to the various types of single-concept films which can be produced and experiences gained by authors who have had considerable contact with production of such films.

Various types of single-concept films were outlined by Scuorzo (19, pp. 81 and 129) as follows:

1. Limited documentaries. These show people and their cultures, such as children on the playground, kindergarten artists at work, people going to work on a busy street, and similar subjects.

2. How-to-do-its. These show a particular task being done in such a manner as to encourage imitation as a means of learning. These films are concerned with the performance of actions in a particular sequence.

3. Explanation. In some instances, we only want to explain a process, not necessarily encourage its imitation.

4. Repetition. These loops serve to drill the student subjects where mastery can be achieved by repetition.

5. Open-end loop. This term does not refer to the loop itself,
but to the fact that it is possible for films depicting desirable or undesirable behavior patterns to be filmed without a conclusion—leaving the proper solution to the class discussion period.

6. Information. Unlike the documentary, no attempt is made in these to present history. Only informational fact is of importance.

Gerlach and Vergis (8) of Arizona State University have conducted summer workshops pertaining to single-concept films and have become quite knowledgable on the subject of production of self-instructional films. A brochure describing the course reads as follows (8, p. 36):

Following an introductory phase, you will begin to develop a script for a subject which you have selected. Simple story-boarding (planning the film through the use of words and visuals) will be your next experience. Then, using the story-board as your guide, you will shoot your picture. Finally, you will edit the processed film into a finished product.

The authors felt that the lack of photographic competence did not greatly hinder students in their class. The success of cartridged loop films depended more on planning and writing of the required script.

The starting point in the production of a self-instructional film, as Gerlach and Vergis saw it, was to define the desired response in the learner. Students' behaviors and responses to be attained through the use of the film must be of prime consideration at all times. With this clearly in mind, the script could be written for the film.

They felt that a manual containing statements of the objectives in behavioral terms should accompany each film. The learners would use this manual along with the film. Gerlach and Vergis (7, p. 202) added that:

When the student knows precisely why he is using the film and how behavior should change as a result of his viewing and performing, he is in a position to optimize the potential of the instructional material to which he is exposed.
The opportunity to head a group which produced 19 single-concept films to be used in teaching physics was had by Miller (16). He (16, p. 9) outlined the guidelines for making these films as follows:

Our single-concept films are more than a mere photographic record of an experiment or demonstration. We aimed at terse exposition and emphasis on key points, omitting background and details that are better supplied by the teacher himself. For this reason, the teachers' guide which is supplied with each film is an integral part of the package. This guide gives theory, numerical data, calculations, and other background material for the teacher's use in preparing his presentation. The teacher cannot expect to get maximal value from a single-concept film without careful study of the teachers' guide; and to show a single-concept film to an unprepared class is to give up an essential value of the format.

The benefits and shortcomings of silent and sound single-concept films were discussed by Kemp and Szumski (12). They pointed out that educational films (16 millimeter format) in recent years predominantly included sound. The authors (12, p. 17) continued by stating that:

There is much subject matter that is predominantly visual in nature and requires motion picture treatment. The concentration of a person's attention on a message carried through the single most perceptive sense, sight, is most effective; and this treatment may require no sound.

With a sound film, attention may be split if the sound track and picture carry messages that may be only casually related.

Anderson (2) felt one advantage of the silent single-concept film was that the teacher could furnish his own verbal accompaniment. This meant that films could become an integral element of a teacher's classroom presentation rather than a substitute or interruption. The films made by Miller (16) were deliberately made without a sound track, intending that they be used by a teacher who supplies a commentary at the level of his own class.
Research and theory related to transmission of audio-visual information was undertaken by Travers (23). One conclusion reached by the author (23, p. 267) was that:

...multiple sensory modality inputs are likely to be of value only when the rate of input of information is very low. The common practice of filling both the audio and the visual channels with a continuous flow of information would seem to have little support, except perhaps that it may satisfy some of the compulsions of film producers. The silent film with the alteration of pictures and print would appear to find much theoretical support as a teaching device.

One other conclusion of interest was drawn by the author. This was the fact that information would not be stored when a "passive learner is passively exposed to inputs". The fact remains that the learner must be aroused and interested and take an active part in order to learn. Travers pointed out that this was sometimes hard to incorporate into audio-visual material since little was known about the type of activities which cause learning to occur.

Several authorities reviewed indicated that the limited use of 16 millimeter educational films in our school systems has been due partially to their lack of sufficient subject matter content for classroom use, and more specifically to inadequate availability of projection equipment. The specialists agreed that the recent expansion in the use of single-concept films could be setting the stage for a type of educational films that will be used widely in the future. The fantastic growth of this form of media has been due largely to an adequate film format appropriately called super 8 millimeter and projection equipment suitable for simple classroom viewing.
Experimental Use of 16 Millimeter Films

A study conducted by LeMaster (13) was designed to determine the effect of pupil learning from specially prepared filmed demonstrations of selected teaching units in introductory woodworking. The films were presented to the class before the manipulative skill was performed by the instructor. The experimental method employing the experimental-control group design was used to collect data for this study.

On the basis of results obtained, the author concluded that the film reinforcement to the manual class demonstration enabled pupils to (1) learn more related technical information and (2) to understand and apply the manipulative skill processes more efficiently. The use of films also enabled the instructor to reduce the number of demonstrations (both small group and individual).

Some interesting conclusions were drawn by Scott (18) when he conducted an experiment using 81 thirty-minute 16 millimeter films from the "Harvey White" T-films series for physics students in 30 randomly selected schools. Thirty schools were also selected to teach the same subject matter by traditional methods. They were termed the control schools. Teacher and student opinions were of prime importance.

Analyses of the data revealed that:

1. Some of the films could be used to replace traditional laboratory work.

2. Most teachers and students felt that the T-films presented too much new material too fast.

3. Many of the teachers disapproved of giving up most of their class time to the films. The T-films represented
another teacher in the classroom.

4. The T-films made their greatest contribution when laboratory facilities or teacher ability was most lacking.

An investigation of the effects of personal characteristics of learners in relation to factual learning from educational films and from classroom presentations of similar material by a teacher was studied by Snow (21). Four hundred and thirty-seven undergraduate physics students at Purdue University were randomly assigned to one of two sections. One group viewed the filmed demonstrations while the other saw the demonstrations performed live by the instructor.

Some audience variables studied by the author were student attitude toward instructional films, attitude toward subject matter presented, numerical aptitude, verbal aptitude, and academic achievement. Results from a subject matter pre-test was used to subdivide each group into three levels of previous knowledge. The aim of the statistical analyses was to discover differences in amount of knowledge gained from the instructional treatments when grouped by previous knowledge and personal characteristics.

It was concluded that personal characteristics of learners determine, to a significant extent, the amount of learning achieved by students in given learning situations. Classroom presentations were superior to filmed presentations for students displaying (1) unfavorable attitudes toward educational films and little previous knowledge of physics and (2) high numerical or verbal aptitude but low or average previous knowledge of physics. Filmed presentations were superior to live presentations for students displaying (1) favorable attitude toward educational films and little previous knowledge of physics and (2) low numerical aptitude but high previous
knowledge of physics. The other variables were not found to be related to student attainment.

Experimental Use of Single-Concept Films

There have been few studies conducted involving the use of single-concept films in actual teaching situations. One such study was conducted by Hannah and Trinklien (15) with 153 Detroit Public School students enrolled in a chemistry course. Three experimental groups of two classes each were established. The purpose of the study was to compare the use of a 16 millimeter educational film versus short clips made from the same film. One group saw only the complete film, once at a recommended time during the study of the unit and once at the close of the unit. The second group viewed the clips twice. The third group saw the complete film at the recommended time and also saw the clips once at designated times throughout the unit.

A statistical analysis using the T-test was completed to compare results on a 40 item objective test given following the completion of the treatments. Results indicated that the use of films plus clips surpassed the other two treatments which were not statistically different. The use of the film clips made the subject matter more comprehensible. The results of the study seemed to indicate that short excerpts from films can be used to teach as effectively as by using complete films. When excerpts were combined with the use of complete films, a significant gain in learning could occur.

The purpose of a study conducted by Gentry (6) was to analyze educational attainment from the use of single-concept films programmed to teach
a science concept through the two contrasted teaching modes of expository and discovery. In the discovery method, the students were to discover the common relationships or elements presented to them as objects or events. In the expository method, the students were presented a concept with a detailed explanation of its application.

Two single-concept films were produced which provided several examples of the science concept to be taught. These films were shown to 280 junior high school science students from one school. The teacher variation was removed by letting the films and an accompanying narration on tape be the only source of teaching. The students were randomly assigned to one of four groups: (1) examples of the concept were in a logically ordered fashion with a discovery narration, (2) the examples were in a random order with a discovery narration, (3) the examples of the concept were in an ordered sequence with an expository narration, and (4) the examples were in a random order with an expository narration. Each of these four groups were then subdivided into two groups, the students with an IQ above 100 and those with IQ's of 100 or below.

One hypothesis tested by Gentry which was of related to this study was that there would be no difference in the retention of science concepts when presented through single-concept films as measured by delayed criterion performance, between students taught by the discovery method and students taught by the expository method, regardless of the sequence of the concepts.

Gentry's conclusion for this hypothesis was that:

Method does not have an effect on the retention of science concepts taught by the single-concept film as measured by the
delayed criterion tasks, regardless of IQ level, and sequence of concept instances.

The remainder of Gentry's findings were excluded since they were not related to this study.

Stein (21) conducted a study designed to test the effectiveness of instruction in beginning typewriting classes using single-concept films. A series of 16 films pertaining to the subject matter taught were produced. The films, a teacher's manual on the films, and projection equipment were provided to three schools which formed the experimental group. Two schools were selected to form the control group. In these schools the students were taught in the conventional manner.

Stein's conclusions were that both the experimental and control groups gained in speed from the first five-minute timed writing, but the experimental group made a significantly greater gain when compared to the control group. The experimental group also significantly out-performed the control group on a test administered at the end of the experiment. The participating teachers indicated that the films served as a good tool for motivation of students and that the classroom projection created virtually no problems.

In another study, Fletcher (4) from Pennsylvania State University, was very concerned with finding an efficient way to teach driver education to the ever increasing number of students enrolled in our high schools. The author (4, p. 20) felt that:

Unless facilities are expanded and advanced teaching methods and aids are developed, more and more students will leave school each year without taking a driver-education program.

Fletcher conducted a study in which he attempted to find a solution to
the vital driver education need of more time for both the students and the teachers. Some roles of the teacher such as actual assistance to students driving a car cannot be substituted by any teaching aid or device. But, there could be substitutes for some of the procedures that the student must understand before he actually drives the car.

The author theorized that film demonstrations with a cartridge-loading projector, which could be operated by the student and repeated under daylight conditions, would enable students to use the motion picture in independent study. Such a procedure could provide standardized individual instruction integrated with actual driving conditions.

One hundred and twelve 11th grade students who had no experience in driving skills were identified by Fletcher and randomly assigned to one of 12 groups. He then prepared four silent film loop cartridges pertaining to the following subject matter: (1) starting the car, (2) putting the car in motion and stopping, (3) backing the car, and (4) turning around on a narrow street.

Four treatment groups were formed with evaluation based on knowledge and driving performance tests. One group viewed the film demonstrations three times, another received three live demonstrations on each area, the third viewed each film three times and received three live demonstrations, and a control group received no formal instruction.

Fletcher (4, p. 21) summed his results as follows:

The first three groups had about the same scores in knowledge tests as to procedures to be followed in developing the particular skills. They also scored equally in their first effort at performing the skill and in the number of practice trials needed to perform correctly the driving skill. Their total performance also rated about equally.
He concluded that film demonstrations could be substituted for live demonstrations without disadvantage to the student.

Fletcher (4, p. 21) stressed that:

The implications of this study are not that films should replace teachers, but, rather, that in the teaching of driving skills teachers are devoting a portion of their valuable time to demonstrating tasks which could be done just as well by film demonstrations used by students in independent study.

The review of literature supported the contention that single-concept films could play a major role in improving classroom instruction. The emergence of single-concept films may continue to be slow as has been most audio-visual aids developed. One possible reason for this lag could be a direct result of the limited number of experimental studies which have been conducted using single-concept films. Such studies would help introduce the use of this new instructional aid by letting classroom teachers become acquainted with its potential. One conclusion reached appears to be that although single-concept films do not out-perform conventional methods, they do as well. The most important conclusion was that in some cases single-concept films could cut instructional time spent by the teacher. The instructor's time has been of such demand that something should be done to reduce the actual instructional time and increase teacher preparation time.
METHOD OF PROCEDURE

This study was designed as a part of a larger study which experimentally evaluated the effectiveness of selected resources and techniques used in teaching vocational agriculture. Seven treatment groups were established for the overall study which were to be compared with each other and with a traditional or a control group as it will be referred to in this study. The treatment groups included were:

1. audio-tutorial,
2. demonstrations,
3. field trips,
4. overhead transparencies,
5. prepared lesson plans,
6. single-concept films, and
7. video-tape.

The experiment was conducted in Iowa high schools offering an approved four-year program of vocational agriculture. The schools in the study had programs with enrollments of at least 36 students. Each of the four classes in these schools had to contain a projected enrollment of not less than eight or more than 22 students. The instructors had at least one year of teaching experience in Iowa.

After the above restrictions were applied to the vocational agriculture departments in the state, a list of qualified schools was formed which served as the population for the overall study. A table of random numbers was used to select 48 schools. Each of the 48 schools was then randomly assigned to one of the seven treatment groups or to the control group.
This resulted in six schools in each group. The seven treatment groups and one control group were the experimental units from which data were collected for the study.

One of four subject matter units selected by the project staff was assigned to each of the four classes in the participating schools. The four units and a brief description of each follow:


2. Commercial fertilizer. The study of the essential plant food elements, crop hunger signs, soil sampling, liming, fertilizer application rates, and selection of fertilizers.

3. Small gasoline engines. The principles of operation of two and four-stroke cycle engines, functions of the engine parts, measuring devices, and preventative maintenance on small gasoline engines.

4. Farm credit. Budgeting principles, types of loans, sources of credit, interest rates, collateral, credit instruments, and the use of farm credit.

A 15 day teaching outline was developed with specific day-by-day objectives for each of the four subject matter units (Appendix A). Uniformity in reference material was achieved by providing all schools with identical teaching materials. Therefore, the participating schools used the same teaching outlines and references and varied their instruction only in use of media.

The control schools taught the same subject matter as the treatment schools but excluded any of the techniques or resources prescribed for the
treatment groups. The control school instructors were to teach in the traditional manner normally used. Any instructional media not prescribed for the treatment groups could be used in the control schools.

Of the 48 schools selected for the entire project, this study was concerned with the six schools assigned to the single-concept film treatment group and the six schools in the traditional or control group. The geographic locations of the six treatment and six control schools are shown in Figure 1. The six schools in the treatment group and the instructors in each school were as follows:

1. Akron -- John Ziniel,
2. Albia -- Howard Willson,
3. Britt -- Alan McFee,
4. Iowa Falls -- Joe White,
5. Maquokata Valley (Delhi) -- Melvin Weber, and
6. Mid-Prairie (Wellman) -- Paul Swank.

The six schools in the control group and the instructors in each school were as follow:

1. Alta -- Harold Carstens,
2. Everly -- Dale Fisher,
3. Hartley -- Harold Woodard,
4. Rock Valley -- Donald Kaberna,
5. Sac City -- Larry Reding, and

The distribution of students within the treatment and control schools is shown in Table 1.

Since there were no single-concept films available for the particular
Figure 1. Geographical location of participating schools
Table 1. Number of students participating in the experiment by school and subject matter area

<table>
<thead>
<tr>
<th>Method</th>
<th>School</th>
<th>Animal health</th>
<th>Commercial fertilizer</th>
<th>Small gasoline engines</th>
<th>Farm credit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-concept</td>
<td>A</td>
<td>17</td>
<td>12</td>
<td>12</td>
<td>9</td>
<td>50</td>
</tr>
<tr>
<td>films</td>
<td>B</td>
<td>10</td>
<td>16</td>
<td>14</td>
<td>13</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>18</td>
<td>12</td>
<td>9</td>
<td>5</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>12</td>
<td>13</td>
<td>16</td>
<td>12</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>19</td>
<td>15</td>
<td>14</td>
<td>16</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>14</td>
<td>22</td>
<td>17</td>
<td>10</td>
<td>63</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>90</strong></td>
<td><strong>90</strong></td>
<td><strong>82</strong></td>
<td><strong>65</strong></td>
<td><strong>327</strong></td>
</tr>
<tr>
<td>Control</td>
<td>A</td>
<td>12</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td>35</td>
</tr>
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<td></td>
<td>B</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>11</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>13</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>11</td>
<td>9</td>
<td>8</td>
<td>10</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>10</td>
<td>9</td>
<td>13</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>16</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>46</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>69</strong></td>
<td><strong>53</strong></td>
<td><strong>58</strong></td>
<td><strong>55</strong></td>
<td><strong>235</strong></td>
</tr>
</tbody>
</table>
units to be taught in the treatment schools, suitable films had to be pro-
duced for each of the subject matter units. Twenty-one silent single-
concept films were developed. The titles and the scripts of the films
which were provided to each instructor are presented in Appendix B. The
films were designed to be used as instructional aids by the instructor in
the classroom. The instructor provided the variation for the film as he
used it. The single-concept films were all short in length, each concen-
trating on and illustrating a specific point, and capable of immediate rep-
etion whenever the instructor so desired.

Each of the six treatment schools were provided with a Technicolor
Super 8 Model 610 Movie-Vision console projector. This model had a rear
view projection unit with a viewing screen approximately 15 by 20 inches in
dimension. The projection equipment was very simple to operate and could
present a picture suitable for viewing by the vocational agriculture
classes. The projector was placed in one of the front corners of the
classroom where it was convenient for the instructor's use and could be
seen easily by class members.

Students in the experiment were administered tests designed to obtain
pertinent descriptive information. Since classes within schools were the
experimental units in the study, student scores in each class were averaged
to comprise class observations to be used in the analyses of data. The
testing program was spread throughout the two months prior to the experi-
ment. The following tests were administered by the counselor in each
school:

1. Otis Quick-Scoring Mental Ability Tests,

2. Kuder General Interest Survey,
3. Nebraska Agriculture Achievement Tests,
4. Differential Aptitude Test - Mechanical Section,
5. Differential Aptitude Test - Abstract Section, and
6. Differential Aptitude Test - Verbal Section.

Immediately before the experiment was to begin, the school counselor administered the pre-test to each student to determine the knowledge possessed by the student in the specific subject matter area involved. The last day of the experiment was set aside for the post-test which would be the dependent variable throughout the analyses of the data collected.

The pre-test and post-test were designed to specifically test the teaching objectives included in the unit outlines provided to the teachers. Since single-concept films could not be produced to cover each of the objectives, certain ones were selected in each subject matter area for which films were produced. Since single-concept films were designed to be used as instructional aids by the instructor when teaching a specific objective, those questions on the tests which dealt directly with the objectives covered by the films were identified. The term pre- and post-tests by objectives was given to these selected portions of the overall tests. Analyses of these results were also of interest in this study.

The four subject matter post-tests were item analyzed to determine the reliability of each test. They were as follows:

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

To help insure as much teacher uniformity as possible throughout the
experiment, the instructors who were selected for the project were given a one-half day briefing at selected locations throughout the state to familiarize them with the experiment. They were then brought to Iowa State University prior to beginning the experiment for a one and one-half day training session. The instructors in the single-concept film group were familiarized with the films and the projection equipment. They had the opportunity to acquaint themselves with narrating the silent films as they were shown. The teaching outlines for each unit and the references to be used were presented to the teachers at this time. Considerable time was spent with the teachers in the control schools to inform them of what they could and could not do while teaching the four units.

The experiment was conducted during a three week period beginning March 24, 1969. The instructors followed the prescribed teaching outlines for each subject matter unit. The single-concept films were injected into the instructional sequence on predetermined days.

Individual student information gathered from each school in the study was coded and placed on data processing cards. From these cards, class means for each school were then calculated and this information was punched onto cards. Since the schools were the experimental units in the first part of this study, class means became the observations which were used in analyzing the data at the Iowa State University Computation Center.

In order to determine if the six treatment schools were similar to the six control schools, single classification analysis of variance F values were calculated for the mean pre-test scores to test the following null hypothesis:
H₀: There are no differences between the mean pre-test scores of the treatment and control schools.

The pre-test values are listed in Table 2 and the pre-test by objectives values are in Table 3. The analysis of variance model used was as follows:

\[ Y = \mu + \alpha_i + \varepsilon_{ij} \]

where

- \( Y \) = class pre-test means
- \( \mu \) = overall grand mean
- \( \alpha_i \) = true treatment effect, \( i = 1 \) for single-concept films and 2 for control
- \( \varepsilon_{ij} \) = random error.

Inspection of the data in the two tables reveal that the treatment and control schools were not different before the experiment was conducted.

The tabled F value with 1 and 11 degrees of freedom at the .05 level used to compare with the calculated F values was 4.84.

The next analysis to be completed on the data was a two factor experiment with repeated measures as explained by Winer (25). This analysis was to determine the difference in knowledge gained by students from the time of the pre-test to the post-test in the treatment and control schools. The model for this analysis was as follows:

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

where

- \( Y_{ijk} \) = class pre-test and post-test means,
- \( \mu \) = overall grand mean,
- \( \alpha_i \) = effect of treatment, \( i = 1 \) for single-concept films and 2 for control,
Table 2. Mean pre-test scores and calculated F values by subject matter unit for the treatment and control groups

<table>
<thead>
<tr>
<th>Subject matter</th>
<th>Single-concept films</th>
<th>Control</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal health</td>
<td>30.53</td>
<td>34.04</td>
<td>1.10</td>
</tr>
<tr>
<td>Commercial fertilizers</td>
<td>29.48</td>
<td>33.62</td>
<td>2.15</td>
</tr>
<tr>
<td>Small gasoline engines</td>
<td>41.23</td>
<td>38.42</td>
<td>.34</td>
</tr>
<tr>
<td>Farm credit</td>
<td>44.55</td>
<td>48.39</td>
<td>.95</td>
</tr>
</tbody>
</table>

Table 3. Mean pre-test scores by objectives and calculated F values by subject matter unit for the treatment and control groups

<table>
<thead>
<tr>
<th>Subject matter</th>
<th>Single-concept films</th>
<th>Control</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal health</td>
<td>32.67</td>
<td>34.71</td>
<td>.27</td>
</tr>
<tr>
<td>Commercial fertilizers</td>
<td>32.42</td>
<td>36.38</td>
<td>1.34</td>
</tr>
<tr>
<td>Small gasoline engines</td>
<td>39.74</td>
<td>36.15</td>
<td>.47</td>
</tr>
<tr>
<td>Farm credit</td>
<td>48.72</td>
<td>51.61</td>
<td>.33</td>
</tr>
</tbody>
</table>

\[ \epsilon_{ij} = \text{effect of the } j^{\text{th}} \text{ class in the } i^{\text{th}} \text{ treatment}, \]

\[ \beta_k = \text{effect of the repeated measure, } k = 1 \text{ for pre-test and } 2 \text{ for post-test}, \]

\[ (\alpha\beta)_{ik} = \text{interaction of the } k^{\text{th}} \text{ repeated measure within the } i^{\text{th}} \text{ treatment}, \text{ and} \]

\[ \delta_{ijk} = \text{random error.} \]
From this analysis, three null hypotheses stated in general form were tested. They were as follows:

1. \( H_0 \): There are no differences between the combined mean pre- and post-test scores of the treatment schools and the combined mean pre- and post-test scores of the control schools.

2. \( H_0 \): There are no differences between the mean pre-test scores of the treatment and control schools and the mean post-test scores of the treatment and control schools.

3. \( H_0 \): There are no differences in the magnitude of change from the mean pre-test scores to post-test scores for the treatment schools as compared with the magnitude of change from the mean pre-test scores to post-test scores for the control schools.

These null hypotheses were tested using the results of each of the four pre- and post-tests for subject matter by objectives and the four overall pre and post subject matter tests.

Analysis of covariance was then used to determine differences between the treatment and control groups. By adjusting the post-test class means for initial differences in classes in the treatment and control groups due to specific variables, a more accurate analysis of true treatment effect could be detected. This was used to test the null hypothesis that:

\( H_0 \): There are no differences between the mean post-test scores of the treatment and control schools when the initial differences between the two groups have been adjusted with respect to a co-variate.

The general model for this analysis with only one covariate was as follows:
\[ Y_{ij} = \mu + \alpha_i + \beta x_{ij} + \varepsilon_{ij} \]

where

- \( Y_{ij} \) = class post-test mean,
- \( \mu \) = overall grand mean,
- \( \alpha_i \) = effect of treatment, \( i = 1 \) for single-concept film and \( 2 \) for control,
- \( \beta \) = slope of the common regression line,
- \( x_{ij} \) = the deviation of any \( X \) from the total mean, and
- \( \varepsilon_{ij} \) = random error.

This model was expanded whenever more than one covariate was added.

Analysis of covariance was also used to adjust students' post-test scores for possible differences which may have been present in the instructors of the treatment and control groups. A score on instructor's knowledge of the subject matter as measured by Beane (3) in a study of the same instructors involved in this study was used as a covariate. Along with this, the instructors were given the Minnesota Teacher Attitude Inventory and the resulting scores were also used as a covariate. An attempt was then made to utilize covariates from both the students and the instructors. It was of interest to determine what effect this may have had in adjusting the students' post-test scores.

Following the above analyses, an attempt was made to identify the factors which characterize the students who performed best when taught with the aid of single-concept films. Correlations and regression analyses were used to measure the contribution of specific variables when predicting academic performance as measured by the post-test scores in the various subject matter units.
Since there were six separate schools which used single-concept films, dummy variables of either 0 or 1 were used to identify the effect that schools may have had on individual student performance. The full model which included all variables used was:

\[
Y_{ij} = \beta_0 X_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \epsilon_{ij}
\]

where:

- \( Y_{ij} \) = post-test scores,
- \( X_0 \) = dummy variable always equal to unity,
- \( X_1, X_2, ..., X_5 \) = dummy variables used for school identification,
- \( X_6 \) = pre-test scores,
- \( X_7 \) = intelligence quotient scores,
- \( X_8 \) = Differential Aptitude Test - Mechanical scores,
- \( X_9 \) = Differential Aptitude Test - Abstract scores,
- \( X_{10} \) = Differential Aptitude Test - Verbal scores,
- \( X_{11} \) = Agriculture Achievement Test scores,
- \( X_{12} \) = Kuder - Outdoor scores,
- \( \beta_0 \) = point at which the regression line intercept the Y axis,
- \( \beta_1, \beta_2, ..., \beta_{12} \) = comprise the slope of the regression line, and
- \( \epsilon_{ij} \) = random error.

The effect of each specific variable in the model was tested in an analysis of variance table. This determined which variables had the greatest influence on post-test scores. The \( \beta \) values served to indicate the direction of the relationship between the variables and the post-test scores.

Similar models using other combinations of variables were also used.
The general hypothesis tested with these analyses was:

\[ H_0: \text{The slope of the regression line is equal to zero.} \]

If this hypothesis was not rejected, the interpretation could be made that the variables were not good predictors of post-test scores. If the hypothesis was rejected, then the variables included in the model did contribute significantly to predicting post-test scores.
FINDINGS

The findings of this study were subdivided into three major categories which included:

1. Analyzing the mean pre- and post-test scores for the treatment and control schools by a two factor experiment using repeated measures.

2. Using analysis of covariance to analyze differences between the adjusted post-test scores of the treatment and control schools.

3. Utilizing individual students in the six treatment schools to determine which type of students performed best when being taught with the aid of single-concept films.

Results reported in this study will at times pertain only to the four specific objectives subject matter tests since they more nearly represented a true effect due to teaching with the aid of single-concept films. The four overall tests included subject matter taught during the entire three week period which was not always with the aid of the films. These results were more apt to contain effects due to extraneous factors uncontrollable in the study. For this reason, findings may be recorded only for the specific objectives tests when the analyses are no different than those for the set of overall tests.

Analysis of the Two Factor Experiment

A two factor experiment using repeated measures was used to analyze the mean pre- and post-test scores of the treatment and control schools. From this analysis, the three null hypotheses stated in the methods chapter were tested.
In an analysis of this type, Winer (25) indicated that the effects tested in the first hypothesis would be completely confounded with differences between the pre-test and post-test means. The corresponding error variance is large which greatly reduces the chance for significance when testing this hypothesis. In testing the other two hypotheses, another error term is used which is not effected by the confounding. They are more sensitive tests.

Analysis for a two factor experiment using the repeated measures of mean pre- and post-test scores by specific objectives from the animal health unit is reported in Table 4. The composite animal health unit mean pre- and post-test scores for the treatment and control schools are given in Table 5. A similar reporting procedure was followed using the specific objectives test results for the commercial fertilizer unit (Tables 6 and 7), small gasoline engines unit (Tables 8 and 9), and the farm credit unit (Tables 10 and 11). Following these tables, the two factor experiment analyses and the composite pre- and post-test means of the four overall subject matter unit test scores are reported in a similar manner (animal health unit — Tables 12 and 13, commercial fertilizers unit — Tables 14 and 15, small gasoline engines unit — Tables 16 and 17, and the farm credit unit — Tables 18 and 19).

Each table reporting the two factor experiment using repeated measures gave results for the three general hypotheses referred to earlier. In each case, the first null hypothesis was not rejected. There were no differences between the combined mean pre- and post-test scores of the treatment schools and the combined pre- and post-test scores of the control schools. It should again be pointed out that this appeared to be a direct result of
Table 4. Analysis of a two factor experiment using the repeated measures of mean pre- and post-test by objectives scores from classes taught the animal health unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>1</td>
<td>215.94</td>
<td>1.88</td>
</tr>
<tr>
<td>Error (a)</td>
<td>10</td>
<td>114.97</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>2098.32</td>
<td>182.35**</td>
</tr>
<tr>
<td>Method x time</td>
<td>1</td>
<td>93.97</td>
<td>8.17*</td>
</tr>
<tr>
<td>Error (b)</td>
<td>10</td>
<td>11.51</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant beyond the five percent level.

**Significant beyond the one percent level.

Table 5. Composite mean pre- and post-test by objectives scores of the treatment and control schools for the animal health unit

<table>
<thead>
<tr>
<th>Method</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-concept films</td>
<td>32.67</td>
<td>47.41</td>
<td>40.04</td>
</tr>
<tr>
<td>Control</td>
<td>34.71</td>
<td>57.37</td>
<td>46.04</td>
</tr>
<tr>
<td>Total</td>
<td>33.69</td>
<td>52.39</td>
<td></td>
</tr>
</tbody>
</table>
Table 6. Analysis of a two factor experiment using the repeated measures of mean pre- and post-test by objectives scores from classes taught the commercial fertilizer unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>1</td>
<td>60.04</td>
<td>.59</td>
</tr>
<tr>
<td>Error (a)</td>
<td>10</td>
<td>101.19</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>2334.05</td>
<td>105.93**</td>
</tr>
<tr>
<td>Method x time</td>
<td>1</td>
<td>3.79</td>
<td>.17</td>
</tr>
<tr>
<td>Error (b)</td>
<td>10</td>
<td>22.03</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Table 7. Composite mean pre- and post-test by objectives scores of the treatment and control schools for the commercial fertilizer unit

<table>
<thead>
<tr>
<th>Method</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-concept</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>films</td>
<td>32.42</td>
<td>52.42</td>
<td>42.68</td>
</tr>
<tr>
<td>Control</td>
<td>36.38</td>
<td>55.31</td>
<td>45.85</td>
</tr>
<tr>
<td>Total</td>
<td>34.40</td>
<td>54.13</td>
<td></td>
</tr>
</tbody>
</table>
Table 8. Analysis of a two factor experiment using the repeated measures of mean pre- and post-test by objectives scores from classes taught the small gasoline engines unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>1</td>
<td>6.68</td>
<td>.11</td>
</tr>
<tr>
<td>Error (a)</td>
<td>10</td>
<td>60.10</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>4782.71</td>
<td>114.40**</td>
</tr>
<tr>
<td>Method x time</td>
<td>1</td>
<td>129.46</td>
<td>3.10</td>
</tr>
<tr>
<td>Error (b)</td>
<td>10</td>
<td>41.81</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Table 9. Composite mean pre- and post-test by objectives scores of the treatment and control schools for the small gasoline engines unit

<table>
<thead>
<tr>
<th>Method</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-concept films</td>
<td>39.74</td>
<td>63.32</td>
<td>51.53</td>
</tr>
<tr>
<td>Control</td>
<td>36.15</td>
<td>69.02</td>
<td>52.59</td>
</tr>
<tr>
<td>Total</td>
<td>37.94</td>
<td>66.17</td>
<td></td>
</tr>
</tbody>
</table>
Table 10. Analysis of a two factor experiment using the repeated measures of mean pre- and post-test by objectives scores from classes taught the farm credit unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>1</td>
<td>128.99</td>
<td>1.37</td>
</tr>
<tr>
<td>Error (a)</td>
<td>10</td>
<td>94.28</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>1567.52</td>
<td>45.67**</td>
</tr>
<tr>
<td>Method x time</td>
<td>1</td>
<td>18.23</td>
<td>.53</td>
</tr>
<tr>
<td>Error (b)</td>
<td>10</td>
<td>34.32</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Table 11. Composite mean pre- and post-test by objectives scores of the treatment and control schools for the farm credit unit

<table>
<thead>
<tr>
<th>Method</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-concept</td>
<td>48.72</td>
<td>63.14</td>
<td>55.93</td>
</tr>
<tr>
<td>films</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>51.61</td>
<td>69.52</td>
<td>60.56</td>
</tr>
<tr>
<td>Total</td>
<td>50.16</td>
<td>66.33</td>
<td></td>
</tr>
</tbody>
</table>
Table 12. Analysis of a two factor experiment using the repeated measures of mean pre- and post-test scores from classes taught the animal health unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>1</td>
<td>354.51</td>
<td>3.74</td>
</tr>
<tr>
<td>Error (a)</td>
<td>10</td>
<td>94.78</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>2248.46</td>
<td>159.36**</td>
</tr>
<tr>
<td>Method x time</td>
<td>1</td>
<td>104.58</td>
<td>7.41*</td>
</tr>
<tr>
<td>Error (b)</td>
<td>10</td>
<td>14.11</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant beyond the five percent level.

**Significant beyond the one percent level.

Table 13. Composite mean pre- and post-test scores of the treatment and control schools for the animal health unit

<table>
<thead>
<tr>
<th>Method</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-concept</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>films</td>
<td>30.53</td>
<td>45.71</td>
<td>38.12</td>
</tr>
<tr>
<td>Control</td>
<td>34.04</td>
<td>57.57</td>
<td>45.81</td>
</tr>
<tr>
<td>Total</td>
<td>32.28</td>
<td>51.64</td>
<td></td>
</tr>
</tbody>
</table>
Table 14. Analysis of a two factor experiment using the repeated measures of mean pre- and post-test scores from classes taught the commercial fertilizer unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>1</td>
<td>55.91</td>
<td>.79</td>
</tr>
<tr>
<td>Error (a)</td>
<td>10</td>
<td>70.65</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>1485.06</td>
<td>83.31**</td>
</tr>
<tr>
<td>Method x time</td>
<td>1</td>
<td>7.07</td>
<td>.39</td>
</tr>
<tr>
<td>Error (b)</td>
<td>10</td>
<td>18.04</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Table 15. Composite mean pre- and post-test scores of the treatment and control schools for the commercial fertilizer unit

<table>
<thead>
<tr>
<th>Method</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-concept</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>films</td>
<td>29.48</td>
<td>46.30</td>
<td>37.89</td>
</tr>
<tr>
<td>Control</td>
<td>33.62</td>
<td>48.26</td>
<td>40.94</td>
</tr>
<tr>
<td>Total</td>
<td>31.55</td>
<td>47.28</td>
<td></td>
</tr>
</tbody>
</table>
Table 16. Analysis of a two factor experiment using the repeated measures of mean pre- and post-test scores from classes taught the small gasoline engines unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>1</td>
<td>21.02</td>
<td>.39</td>
</tr>
<tr>
<td>Error (a)</td>
<td>10</td>
<td>53.87</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>3852.68</td>
<td>92.93**</td>
</tr>
<tr>
<td>Method x time</td>
<td>1</td>
<td>131.32</td>
<td>3.16</td>
</tr>
<tr>
<td>Error (b)</td>
<td>10</td>
<td>41.46</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Table 17. Composite mean pre- and post-test scores of the treatment and control schools for the small gasoline engines unit

<table>
<thead>
<tr>
<th>Method</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-concept films</td>
<td>41.23</td>
<td>61.89</td>
<td>51.56</td>
</tr>
<tr>
<td>Control</td>
<td>38.42</td>
<td>68.44</td>
<td>53.43</td>
</tr>
<tr>
<td>Total</td>
<td>39.83</td>
<td>65.17</td>
<td></td>
</tr>
</tbody>
</table>
Table 18. Analysis of a two factor experiment using the repeated measures of mean pre- and post-test scores from classes taught the farm credit unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>1</td>
<td>184.59</td>
<td>2.54</td>
</tr>
<tr>
<td>Error (a)</td>
<td>10</td>
<td>72.67</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1</td>
<td>1234.67</td>
<td>48.92**</td>
</tr>
<tr>
<td>Method X time</td>
<td>1</td>
<td>17.44</td>
<td>.69</td>
</tr>
<tr>
<td>Error (b)</td>
<td>10</td>
<td>25.24</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Table 19. Composite mean pre- and post-test scores of the treatment and control schools for the farm credit unit

<table>
<thead>
<tr>
<th>Method</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-concept films</td>
<td>44.55</td>
<td>57.19</td>
<td>50.87</td>
</tr>
<tr>
<td>Control</td>
<td>48.39</td>
<td>64.44</td>
<td>56.42</td>
</tr>
<tr>
<td>Total</td>
<td>46.47</td>
<td>60.82</td>
<td></td>
</tr>
</tbody>
</table>
the confounding effect due to differences in the mean pre- and post-test scores for classes.

Similar results are shown in each table on interpretation of the second hypothesis. In each case the null hypothesis was rejected. The mean pre-test scores of the treatment and control schools were found to be different than the mean post-test scores of these schools. A significant amount of knowledge as measured by the pre- and post-tests was gained during the three week units of instruction.

Interpretations of the third hypothesis are not similar in all tables. In the specific objectives (Table 4) and the overall (Table 12) tests results for the animal health unit, the third hypothesis was rejected. The magnitude of change from the mean pre-test to the mean post-test scores was not the same for the treatment schools and the control schools. In both cases, inspection of the respective table of means (Tables 5 and 13) indicated that the control schools tended to show a much greater increase in knowledge from the pre-test to the post-test.

Data in Table 5 reveal that the single-concept film schools progressed from an average pre-test score of 32.67 to a 47.41 average post-test score. This was in contrast to the control schools which began with a 34.71 average pre-test score and advanced to a 57.37 average post-test score. A similar magnitude of change shown in Table 13 explains the resulting significance shown for hypothesis three in Table 12.

In the analysis for the other three units of instruction, the null hypothesis was not rejected. The increase in knowledge was similar for the treatment and control schools.
Analysis of Covariance

Analysis of covariance was used to analyze the effectiveness of single-concept films as an instructional aid when compared with the use of the traditional method. This statistical procedure accounts for initial group differences with respect to particular variables when analyzing the mean post-test scores of the treatment and control schools. Since the sampling procedure used in this study did not insure that the treatment and control groups would be equal on all variables, the statistic should be beneficial. The result should be a more accurate analysis of the data.

The combined mean pre-test by objectives, intelligence quotient, agriculture achievement, and unadjusted and adjusted post-test by objectives mean scores for the treatment and control classes taught the animal health unit are presented in Table 20. The unadjusted post-test mean was 47.41 for the treatment schools and 57.37 for the control schools. When a single-classification analysis of variance was computed for the unadjusted means of the two groups of schools, a calculated F value of 3.66 was found. Although this was not a significant F value, the control schools' mean was considerably greater than that of the treatment schools.

Inspection of the pre-test, intelligence quotient, and agriculture achievement mean scores reveal that the control schools showed greater ability in all areas. When this was accounted for, the adjusted mean post-test score was 50.38 for the treatment schools and 54.40 for the control schools. When the analysis of covariance was computed using the above variables as covariates, the calculated F value as shown in Table 21 was reduced to 1.64.

When intelligence quotient was the only covariate used, it had a
Table 20. Effect of the covariates (pre-test, intelligence quotient, and agriculture achievement mean scores) on the specific objectives animal health unit post-test mean scores

<table>
<thead>
<tr>
<th>Groups</th>
<th>Covariates</th>
<th>Post-test</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td>IQ</td>
<td>Agriculture</td>
<td>Unadjusted</td>
</tr>
<tr>
<td>Single-concept</td>
<td>32.67</td>
<td>97.52</td>
<td>49.32</td>
<td>47.41</td>
</tr>
<tr>
<td>films</td>
<td>Control</td>
<td>34.71</td>
<td>101.96</td>
<td>57.41</td>
</tr>
</tbody>
</table>

Table 21. Analysis of covariance for the mean animal health unit post-test by objectives scores of the treatment and control schools using the pre-test, intelligence quotient, and agriculture achievement test school means as covariates

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>1</td>
<td>33.05</td>
<td>1.64</td>
</tr>
<tr>
<td>Error</td>
<td>7</td>
<td>20.16</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

greater adjusting effect than that found from the use of three covariates at one time. The resulting adjusted combined post-test by objectives mean scores were 50.76 for the treatment schools and 54.02 for the control schools. The calculated analysis of covariance F value shown in Table 22 was 1.37. Various other combinations of variables were used as covariates
Table 22. Analysis of covariance for the mean animal health unit post-test by objectives scores of the treatment and control schools using intelligence quotient test school means as the covariate

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>1</td>
<td>24.33</td>
<td>1.37</td>
</tr>
<tr>
<td>Error</td>
<td>9</td>
<td>17.72</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

but none were as effective as intelligence quotient used alone.

The use of individual class mean scores on specific independent variables as covariates could not be used on analysis of covariance when analyzing the post-test scores of the commercial fertilizer and small gasoline engines units. An assumption for covariance analysis that the correlation of a particular independent variable with the dependent variable must be similar for the groups being compared before it can be used as a covariate was violated. An example of this could be illustrated by comparing the treatment school's correlation of -.7659 for the by specific objectives small gasoline engines unit pre-test with post-test scores to the corresponding correlation for the control schools which was .6633.

Since no variables could be found which were suitable for the covariance analysis, a different statistical technique was used to analyze the post-test by specific objectives scores of the treatment and control schools. The procedure selected was an analysis of variance design involving blocking. The schools were blocked into three groups according to
the student pre-test by objectives scores and then analyzed on their post-test by objectives scores. The analyses for the two separate classes are presented in Tables 23 and 24.

Table 23. Analysis of variance for the mean post-test commercial fertilizer unit scores of the treatment and control schools after blocking by use of school pre-test mean scores

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blocks</td>
<td>2</td>
<td>12.35</td>
<td></td>
</tr>
<tr>
<td>Groups</td>
<td>1</td>
<td>.11</td>
<td>.001</td>
</tr>
<tr>
<td>Error</td>
<td>8</td>
<td>108.96</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 24. Analysis of variance for the mean post-test small gasoline engines unit scores of the treatment and control schools after blocking by use of school pre-test mean scores

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blocks</td>
<td>2</td>
<td>14.96</td>
<td></td>
</tr>
<tr>
<td>Groups</td>
<td>1</td>
<td>23.02</td>
<td>.77</td>
</tr>
<tr>
<td>Error</td>
<td>8</td>
<td>29.73</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results were similar in both cases. Data in neither table indicate any differences in the achievement of the treatment and control schools as measured by the post-test scores. If the F value would have been calculated for the blocking effect, it would have been shown that little was gained as a result of this technique.

The error term for the commercial fertilizer unit by specific objectives analysis was extremely large (108.96). This was largely due to the wide variation found in post-test scores for schools within groups. This extreme variation did not occur in the small gasoline engines unit where the error term was not as large (29.73).

Analysis of covariance could again be used when analyses were made on data for the farm credit unit. The combined unadjusted post-test means for the treatment (63.14) and control (69.52) classes taught the farm credit unit are found in Table 25. The calculated F value from a single-classification analysis of variance computation between the schools on the post-test scores was 2.32.

Table 25. Effects of the covariates (pre-test, intelligence quotient, and agriculture achievement mean scores) on the specific objectives farm credit unit post-test mean scores

<table>
<thead>
<tr>
<th>Groups</th>
<th>Covariates</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td>IQ</td>
</tr>
<tr>
<td>Single-concept films</td>
<td>48.72</td>
<td>100.10</td>
</tr>
<tr>
<td>Control</td>
<td>51.61</td>
<td>104.77</td>
</tr>
</tbody>
</table>
The control schools farm credit unit classes had higher scores for the variables of pre-test, intelligence quotient, and agriculture achievement when compared with the treatment schools. When these initial differences were accounted for, the adjusted post-test combined mean for the treatment schools was 67.76. The control schools had a mean of 64.90. When the analysis of covariance was computed, the new calculated F value as shown in Table 26 was .22. The adjustment in this case resulted in the treatment schools outperforming the control schools but not at a significant level.

Table 26. Analysis of covariance for the mean farm credit unit post-test by objectives scores of the treatment and control school using the pre-test, intelligence quotient, and agriculture achievement test school means as covariates

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>1</td>
<td>8.56</td>
<td>.22</td>
</tr>
<tr>
<td>Error</td>
<td>7</td>
<td>39.41</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The combination of three covariates used had more effect on adjusting the post-test means than did any other combination of variables tested. The results from the covariance analyses on the specific objectives tests were no different than those found for the overall test analyses.

Analysis of covariance was also used to adjust student post-test by specific objectives scores for possible differences which may have existed between the instructors of the treatment and control groups. Two measure-
ments of the instructors were utilized. These included the Minnesota Teacher Attitude Inventory and the instructor's knowledge of the subject matter as measured by Beane (3) in a study of the same instructors involved in this study.

The problem again arose that the correlations of the variables and the post-test were unequal for the treatment and control classes. They could not be used as covariates for this reason. Both variables for the animal health unit were unequally correlated, teacher knowledge of the commercial fertilizer unit could not be used, and the Minnesota Teacher Attitude Inventory was not useable in the farm credit unit. Neither variable violated the required assumption in the small gasoline engines unit. Whenever possible, student scores on independent variables were also used as covariates in conjunction with the teacher variables.

No further analyses of covariance were possible for the animal health unit. The use of the Minnesota Teacher Attitude Inventory scores as a covariate in the commercial fertilizer unit was possible. All of the independent student variables violated the required assumption and could not be used as covariates in this unit. For that reason, no combination of instructor and student measures were used together as covariates.

A calculated F value of .19 was derived for the combined unadjusted post-test class means shown in Table 27. When the adjustment was made for the Minnesota Teacher Attitude Inventory, the calculated F value decreased to .075 as shown by data in Table 28. This variable did very little in changing the existing post-test by specific objectives scores of the commercial fertilizer unit classes. The new combined adjusted post-test means for these classes were 53.85 for the treatment schools and 54.40 for the
Table 27. Effect of the covariate (Minnesota Teacher Attitude Inventory) on the specific objectives commercial fertilizer post-test mean scores

<table>
<thead>
<tr>
<th>Groups</th>
<th>Minnesota Teacher Attitude Inventory</th>
<th>Post-test</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Unadjusted</td>
<td>Adjusted</td>
<td></td>
</tr>
<tr>
<td>Single-concept</td>
<td>43.50</td>
<td>52.94</td>
<td>53.85</td>
<td></td>
</tr>
<tr>
<td>films</td>
<td></td>
<td>52.67</td>
<td>55.31</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>54.40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 28. Analysis of covariance for the mean commercial fertilizer unit post-test by objectives scores for the treatment and control schools using the Minnesota Teacher Attitude Inventory test scores as a covariate

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>1</td>
<td>6.83</td>
<td>.075</td>
</tr>
<tr>
<td>Error</td>
<td>9</td>
<td>90.96</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

control schools.

The small change in the calculated F values was largely due to the magnitude of the error mean square shown in Table 28. This was a result of the extreme variation within the class post-test mean scores of the groups themselves. This was especially true in the control group which had post-test scores ranging from a low of 38.80 to a high of 74.33. The variation
within groups for the scores on the independent variable also had an effect in decreasing the adjusting factor which occurred.

In the small gasoline engines unit, analysis of covariance using instructor variables was run three different ways. Once using instructor's knowledge of subject matter as the covariate, once using the Minnesota Teacher Attitude Inventory test scores as the covariate, and once using both scores simultaneously in an analysis of covariance. The analysis using only the Minnesota Teacher Attitude Inventory test scores had the greatest effect in reducing the calculated F value of 5.09 for the combined unadjusted post-test class means found in Table 29. The new calculated F value was 4.23 as shown in Table 30. Both of these F values were approaching significance and both showed the control schools having the greatest achievement. Again the adjustment brought about by this variable was only slight.

In the farm credit unit, the most effective covariance analysis incorporating teacher variables was found when students' intelligence quotient
Table 30. **Analysis of covariance for the mean small gasoline engines unit post-test by objectives scores for the treatment and control schools using the Minnesota Teacher Attitude Inventory test scores as a covariate**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>1</td>
<td>88.98</td>
<td>4.24</td>
</tr>
<tr>
<td>Control</td>
<td>9</td>
<td>21.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

and instructor's knowledge of the subject matter were used together as covariates. Data in Table 32 present this analysis. A calculated F value of 2.32 was found when analyzing the difference in the combined unadjusted means of the treatment and control schools which were shown in Table 31.

Table 31. **Effect of the covariates (intelligence quotient and teacher knowledge) on the specific objectives farm credit post-test mean scores**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Covariates</th>
<th>Post-test</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intelligence quotient</td>
<td>Teacher knowledge</td>
<td>Unadjusted</td>
</tr>
<tr>
<td>Single-concept films</td>
<td>100.10</td>
<td>26.33</td>
<td>63.14</td>
</tr>
<tr>
<td>Control</td>
<td>104.77</td>
<td>29.33</td>
<td>69.52</td>
</tr>
</tbody>
</table>

The calculated F value was changed to .018 for the adjusted means. The treatment schools had a larger mean (66.68) than the control schools...
Table 32. Analysis of covariance for the mean farm credit unit post-test by objectives scores for the treatment and control schools using students' intelligence quotient and teacher knowledge as co-variates

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>1</td>
<td>.76</td>
<td>.018</td>
</tr>
<tr>
<td>Error</td>
<td>8</td>
<td>41.25</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(65.99) for this unit after adjustment.

Analyzing Individual Student Performance with Single-Concept Films

Of interest in this study was the performance of individual students on the post-test in the respective subject matter areas. An attempt was made to determine the characteristics of the students who performed best when taught with the aid of single-concept films.

Correlations computed between selected variables and the post-test by specific objectives scores are presented for the four subject matter units in Table 33. The students' scores on most of these variables were quite highly correlated with the post-test scores. These high correlations were helpful in determining the characteristics of students who performed best when taught with the aid of single-concept films. In only one instance was there a negative correlation and this was not found to be significant when compared with the tabled value at the five percent level.

The magnitude of some of the correlations would tend to indicate that
Table 33. Correlation of specific student variables with the post-test by objectives scores for the four subject matter units in the treatment schools

<table>
<thead>
<tr>
<th>Variables</th>
<th>Animal health</th>
<th>Commercial fertilizers</th>
<th>Small gasoline engines</th>
<th>Farm credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>.5089</td>
<td>.6139</td>
<td>.4358</td>
<td>.6386</td>
</tr>
<tr>
<td>IQ</td>
<td>.5962</td>
<td>.5727</td>
<td>.4620</td>
<td>.5266</td>
</tr>
<tr>
<td>DAT - Mechanical</td>
<td>.3795</td>
<td>.2432</td>
<td>.4119</td>
<td>.3285</td>
</tr>
<tr>
<td>DAT - Abstract</td>
<td>.1926</td>
<td>.4261</td>
<td>.4919</td>
<td>.5641</td>
</tr>
<tr>
<td>DAT - Verbal</td>
<td>.5038</td>
<td>.5099</td>
<td>.4006</td>
<td>.6287</td>
</tr>
<tr>
<td>Agriculture achievement</td>
<td>.5299</td>
<td>.5555</td>
<td>.5749</td>
<td>.5718</td>
</tr>
<tr>
<td>Kuder - Outdoor</td>
<td>.3351</td>
<td>.2693</td>
<td>-.0673</td>
<td>.0958</td>
</tr>
</tbody>
</table>

the relationship between the variable and the post-test was quite pronounced. Four of the seven variables listed seemed to be consistently high throughout all subject matter areas. They were pre-test, intelligence quotient, Differential Aptitude Test (Verbal section), and the agriculture achievement scores.

Looking more specifically at each subject matter unit, the students in the animal health unit had four variables which correlated greater than .5000 with the post-test. They were the same four variables as those stated above for the general case. The specific correlation for intelligence quotient (.5962) indicates that the students with the high intelligence quotient scores also had the higher post-test scores. A similar interpretation could also be made for all other correlations which were positively related.

The same conclusion could be made for the commercial fertilizer unit as was made for the animal health unit. The same four variables again cor-
related above .5000 with the post-test. This did not hold true for students in the small gasoline engines classes. The lowest correlations for a subject matter unit as a whole were recorded for this group of students. Only the agriculture achievement correlation (.5749) was greater than .5000. The Differential Aptitude Test (Abstract section) had the next largest correlation (.4919) for this group.

A similar magnitude for the Differential Aptitude Test (Abstract section) was found in the farm credit unit. Here the correlation was .5641. The verbal section of the Differential Aptitude Test also was quite high (.6287). This correlation was exceeded only by that of the pre-test (.6386) in this subject matter unit. This was also the highest correlation recorded for any variable in any of the classes. The other variables of intelligence quotient and agriculture achievement again had high correlations (.5266 and .5718, respectively). The farm credit unit had the largest number of variables which were highly correlated with the post-test.

The Kuder General Interest Survey (Outdoor section) tended to be the least correlated with post-test scores of any of the variables listed. The correlations recorded for the Differential Aptitude Test (Mechanical section) were not much greater. The highest correlation for this variable (.4119) was found for the small gasoline engines unit.

The same correlations as calculated for the students in the treatment schools were computed for the students in the control schools and presented in Table 34. The correlations were quite similar to those found for the students in the treatment schools. Again the four variables of pre-test, intelligence quotient, Differential Aptitude Test (Verbal section), and agriculture achievement test scores were correlated highly with the specific
Table 34. Correlation of specific student variables with the post-test by objectives scores for the four subject matter units in the control schools

<table>
<thead>
<tr>
<th>Variables</th>
<th>Animal health</th>
<th>Commercial fertilizers</th>
<th>Small gasoline engines</th>
<th>Farm credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>.5262</td>
<td>.6474</td>
<td>.4282</td>
<td>.6486</td>
</tr>
<tr>
<td>IQ</td>
<td>.6637</td>
<td>.6833</td>
<td>.3005</td>
<td>.7109</td>
</tr>
<tr>
<td>DAT - Mechanical</td>
<td>.4398</td>
<td>.3787</td>
<td>.5021</td>
<td>.3800</td>
</tr>
<tr>
<td>DAT - Abstract</td>
<td>.6555</td>
<td>.2260</td>
<td>.5009</td>
<td>.3289</td>
</tr>
<tr>
<td>DAT - Verbal</td>
<td>.6297</td>
<td>.5181</td>
<td>.4191</td>
<td>.6102</td>
</tr>
<tr>
<td>Agriculture achievement</td>
<td>.5627</td>
<td>.6157</td>
<td>.4453</td>
<td>.6102</td>
</tr>
<tr>
<td>Kuder - Outdoor</td>
<td>.3041</td>
<td>.2983</td>
<td>.1026</td>
<td>.0861</td>
</tr>
</tbody>
</table>

In addition to the four variables mentioned above, the Differential Aptitude Test (Abstract section) correlation (.6555) with the animal health unit specific objectives post-test was quite high. There were four correlations for the commercial fertilizer unit that were above .5000. They were pre-test (.6474), intelligence quotient (.6833), Differential Aptitude Test - Verbal section (.5181), and agriculture achievement test (.6157).

The students' correlations for the control schools' small gasoline engines unit were similar to the treatment schools' correlations in that they were relatively low when compared to the other units. In the control schools, the Differential Aptitude Test (Mechanical section) had the highest correlation (.5021). In this unit the variables of pre-test and intelligence quotient were not very high (.4282 and .3005, respectively). The correlation for the Mechanical and Abstract aptitude scores indicated that these measures seemed to be the most closely related to achievement in
The farm credit unit had four correlations which were greater than .6000. Again they were pre-test (.6486), intelligence quotient (.7109), Differential Aptitude Test - Verbal section (.6102), and the agriculture achievement test (.6102). The correlation between the intelligence quotient and the post-test scores was the highest correlation found for the students in the control schools.

The regression analysis format was also used to help solve the problem of determining the variables which influenced students' post-test scores the most. Since the students were found in six different schools, terms represented by dummy variables were included in the regression model to determine the effect that the schools may have had on student performance. Measurements for other variables included in the full model were from scores on the pre-test, intelligence quotient, Differential Aptitude Test (Mechanical, Verbal, and Abstract sections), agriculture achievement, and Kuder General Interest Survey (Outdoor section). All of these variables were fitted into a regression model and their effectiveness in predicting post-test scores was analyzed.

The multiple regression analyses for the animal health, commercial fertilizers, small gasoline engines, and farm credit units post-test by specific objectives scores were presented in Tables 35, 36, 37, and 38. In each case, the calculated F value was significant beyond the one percent level.

The sizes of the multiple R squares were also of interest. They are generally used as a measure of the success of the regression equation in explaining the variation in the data one is working with. The values found
Table 35. Analysis of multiple regression of post-test by objectives scores for the students taught the animal health unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 variable regression</td>
<td>12</td>
<td>839.67</td>
<td>6.63**</td>
</tr>
<tr>
<td>Residual</td>
<td>64</td>
<td>126.61</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple $R^2 = .5543$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sh $R^2 = .4707$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Table 36. Analysis of multiple regression of post-test by objectives scores for the students taught the commercial fertilizer unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 variable regression</td>
<td>12</td>
<td>1,306.94</td>
<td>13.97**</td>
</tr>
<tr>
<td>Residual</td>
<td>74</td>
<td>93.53</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple $R^2 = .6938$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sh $R^2 = .6440$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

in each table indicate that the models were accounting for a major portion of the total variation existing in the students' post-test by specific objectives scores. The commercial fertilizer unit showed the greatest multiple $R^2$ value which was .6938. Two were slightly greater than .6000 and the
Table 37. Analysis of multiple regression of post-test by objectives scores for the students taught the small gasoline engines unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 variable regression</td>
<td>12</td>
<td>804.56</td>
<td>8.45**</td>
</tr>
<tr>
<td>Residual</td>
<td>59</td>
<td>95.17</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple $R^2 = .6323$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Sh R^2 = .5575$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Table 38. Analysis of multiple regression of post-test by objectives scores for the students taught the farm credit unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 variable regression</td>
<td>12</td>
<td>719.68</td>
<td>5.86**</td>
</tr>
<tr>
<td>Residual</td>
<td>44</td>
<td>122.79</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple $R^2 = .6152$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Sh R^2 = .5103$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

one for the animal health unit was lowest at .5543.

Shrunken multiple $R^2$ squares were also calculated for each table. These values correct for overinflation resulting from calculating the multiple $R^2$ from a sample. It provides a value which is more representative
63

of the population. It adjusts for the sample size and the number of variables used in the prediction equation. When these values were calculated, they were still considerably large. The shrunken $R^2$ for the commercial fertilizer unit (.6440) was the largest. A value of .4707 for the animal health unit was the smallest.

The results of analyses of tests over all subject matter were no different than that found for the by specific objectives tests analyses. To reduce redundancy, these results were not tabled and presented.

The number of students included in each class can be found by adding one to the respective total degrees of freedom found in the last four tables. The number of students in each class did vary somewhat. The figures were also somewhat lower than the number recorded in the methods chapter. A student was excluded from the analysis if measurements for all variables used in the model were not available for him.

Attention was then turned to analyses which were performed in order to determine if the contribution due to schools was important to the model. This was accomplished by rerunning the same multiple regression equation with the terms representing schools excluded. By comparing the results from such analyses with that for the full model, the significance of the contribution of schools could be determined. This analysis for the animal health unit post-test by specific objectives scores was presented in Table 39.

The sum of squares for the reduced model was subtracted from the sum of squares for the full model. The term resulting from this subtraction represented the sum of squares due to schools. The mean square was found by dividing through by the degrees of freedom associated with the six
Table 39. Testing the loss due to elimination of individual school identification from the full model for students taught the animal health unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 variable regression</td>
<td>12</td>
<td>10,075.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 variable regression</td>
<td>7</td>
<td>8,071.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss due to elimination of school identifi</td>
<td>5</td>
<td>2,004.05</td>
<td>400.81</td>
<td>3.17*</td>
</tr>
<tr>
<td>cation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual</td>
<td>64</td>
<td>8,103.23</td>
<td>126.61</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>76</td>
<td>18,179.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant beyond the five percent level.

classes in the six schools which were taught the animal health unit. This mean square was then divided by the residual mean square from the full model. The result was a calculated F value (3.17) which was compared to a tabled F value at 5 and 64 degrees of freedom. The calculated F value for this analysis was significant at the five percent level. This provided a test for the null hypothesis that:

\[ H_0: \text{The effect due to schools does not influence students' performance on the post-test.} \]

This null hypothesis was rejected indicating that the schools did influence the students' performance. The terms used to identify schools must be left in the model in this case. A similar procedure was used to analyze the other subject matter unit's post-test by specific objectives scores.

The results from analyses of the commercial fertilizer and small gaso-
line engines units found in Tables 40 and 41 indicated that the loss due to the elimination of school indentification from the model was highly significant. This meant that enough of the variation in the students' post-test scores was being explained by the schools that the terms identifying them could not be dropped from the model.

Table 40. Testing the loss due to the elimination of individual school identification from the full model for students taught the commercial fertilizer unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 variable regression</td>
<td>12</td>
<td>15,683.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 variable regression</td>
<td>7</td>
<td>12,726.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss due to elimination of school identification</td>
<td>5</td>
<td>2,957.04</td>
<td>591.41</td>
<td>6.32**</td>
</tr>
<tr>
<td>Residual</td>
<td>74</td>
<td>6,921.05</td>
<td>93.53</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>86</td>
<td>22,604.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Data in Table 42 indicate that the above conclusions did not hold for the analysis of the farm credit unit post-test by specific objectives scores for students. Here the calculated F value of 1.12 was not significant. The identification of schools in the model could be ignored.

The results for the overall farm credit unit post-test scores analysis as shown in Table 43 did not give the same results as that found for the specific objectives test analysis. The scores on the two post-tests must
Table 41. Testing the loss due to the elimination of individual school identification from the full model for students taught the small gasoline engines unit

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 variable regression</td>
<td>12</td>
<td>9,654.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 variable regression</td>
<td>7</td>
<td>7,284.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss due to elimination of school identification</td>
<td>5</td>
<td>2,369.81</td>
<td>473.96</td>
<td>4.98**</td>
</tr>
<tr>
<td>Residual</td>
<td>59</td>
<td>5,615.05</td>
<td>95.17</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>15,269.78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

Table 42. Testing the loss due to the elimination of individual school identification from the full model for students taught the farm credit unit (specific objectives test results)

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 variable regression</td>
<td>12</td>
<td>8,636.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 variable regression</td>
<td>7</td>
<td>7,948.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss due to elimination of school identification</td>
<td>5</td>
<td>688.05</td>
<td>137.61</td>
<td>1.12</td>
</tr>
<tr>
<td>Residual</td>
<td>44</td>
<td>5,402.66</td>
<td>122.79</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>14,038.88</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 43. Testing the loss due to the elimination of school identification from the full model for students taught the farm credit unit (overall test results)

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 variable regression</td>
<td>12</td>
<td>7,377.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 variable regression</td>
<td>7</td>
<td>5,716.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss due to elimination of school identification</td>
<td>5</td>
<td>1,660.96</td>
<td>332.19</td>
<td>4.12**</td>
</tr>
<tr>
<td>Residual</td>
<td>44</td>
<td>3,551.37</td>
<td>80.71</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>10,928.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant beyond the one percent level.

have been different. The significant F value indicates that the school identification could not be ignored from the model when looking at the overall test results. Since the overall test may have been effected more greatly by extraneous variables uncontrollable in the study than the specific objectives results, the latter results will be weighed more heavily in the final interpretation of the farm credit unit. All other units had similar overall test and specific objectives test results.

Regression analyses using the same variables as those used in analyses of the students in the treatment schools were also performed on the students in the control schools. All calculated F values for the full models were found to be significant. Data in Table 44 present a summary of the multiple and shrunken R² values for each of the four subject matter units using the specific objectives post-test results as the variable that was
Table 44. Multiple and shrunken $R^2$ values for the four subject matter units taught to students in the control schools

<table>
<thead>
<tr>
<th>Subject matter units</th>
<th>Multiple $R^2$</th>
<th>Shrunken $R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal health</td>
<td>.6238</td>
<td>.5147</td>
</tr>
<tr>
<td>Commercial fertilizers</td>
<td>.7571</td>
<td>.6769</td>
</tr>
<tr>
<td>Small gasoline engines</td>
<td>.4885</td>
<td>.3146</td>
</tr>
<tr>
<td>Farm credit</td>
<td>.7568</td>
<td>.6863</td>
</tr>
</tbody>
</table>

The $R^2$ values for the control schools were quite large in all but the small gasoline engines unit. The calculated $F$ value testing this unit's full model was only significant at the five percent level, whereas all other $F$ values were significant beyond the one percent level. The multiple $R^2$ value for the commercial fertilizer unit was the largest (.7571) of the values for the control schools' subject matter units as was the case for the treatment schools (.6938). The shrunken $R^2$ for the farm credit unit was found to be the largest (.6863) for the control group.

The regression models for the students in the control schools were rerun excluding the five dummy variables used to identify the six different schools included in this group. The loss due to elimination of these variables from the full model was calculated. Results for the specific objectives and the overall subject matter post-tests were similar. Interpretation of the calculated $F$ values associated with the loss in the animal health, commercial fertilizer, and small gasoline engines units were not
significant. The variables used to identify schools could be dropped from
the full model. This did not hold true for the farm credit unit. Here the
loss was found to be significant and the terms could not be dropped from
the model. These results were almost in direct contrast to the findings
for the treatment schools when testing the loss due to the elimination of
school variables.
DISCUSSION

Analyses were performed in this study to help find answers to the following objectives:

1. To determine the effectiveness of single-concept films as an instructional aid in teaching vocational agriculture.
2. To determine selected interest and ability characteristics of students who achieve best when taught with the aid of single-concept films.

The mean pre-test scores for the four subject matter units taught in the treatment and control schools were first analyzed. Analyses revealed that the mean scores were not different for the treatment and control schools. This supported the contention that the students in the 12 schools did not differ appreciably in prior knowledge of the subject matter that was to be taught. A closer look at these statistically nonsignificant mean scores revealed that in all but the small gasoline engines unit, the control schools had higher mean pre-test scores. These scores should not have reflected much teacher influence. From the point when instruction began, however, this may no longer have been true.

When the two factor experiment using the repeated measures of pre-test and post-test scores was used, it provided a test which determined if the magnitude of change in knowledge from the pre-test to the post-test was different for the treatment and control schools. Such a difference was found in the animal health unit. The specific objectives test results for the single-concept film schools changed from an average pre-test score of 32.67 to a 47.41 average post-test score. The change in scores for the control schools was from 34.71 to 57.37. Similar analyses for the other
three units were not found to be significant.

The mean post-test score for the animal health unit taught in the control schools was considerably larger than the mean for the treatment schools. This also held true for the other units. The mean specific objectives post-test scores in the control schools for the commercial fertilizer, small gasoline engines, and farm credit units were 55.31, 69.02, and 69.52, respectively. The scores for the same units in the treatment schools were 52.41, 63.32, and 63.14. The advantage the control schools had from these post-test scores was hard to overcome in all analyses conducted which compared the performance of students in the treatment versus the control schools.

Inspection of the independent variables used as covariates in the analysis of covariance computations revealed that the average scores of the students in the control schools were considerably higher than the average scores of the students in the treatment schools on all variables measured in the four subject matter units. This could be illustrated by comparing the average intelligence quotient and agriculture achievement scores for students in the farm credit unit in the treatment and control schools. The students in the treatment schools had average scores of 100.10 and 57.57, respectively, as compared to 104.77 and 69.36 in the control schools.

This may explain the higher post-test scores in the control schools. These post-test scores were greater (almost statistically significant) than the post-test scores in the treatment schools for all four subject matter units. The students in the control schools possessed more ability than did the students in the treatment schools. The covariance analyses which accounted for initial student differences and then adjusted post-test scores
accordingly could not overcome the advantage the control schools had on post-test scores. The post-test adjusted means for the treatment schools could at best be only slightly higher than the adjusted post-test means for the control schools. The adjustment factor in the farm credit unit raised the average specific objectives post-test score for the treatment schools from 63.14 to 67.76. The control schools' average score was lowered from 69.52 to 64.90. This was a substantial change in scores, but not sufficient to show any significance. The most effective student independent variables found as covariates were pre-test, intelligence quotient, and agriculture achievement test scores.

An attempt was made to associate some of the variation in the students' post-test mean scores of the treatment and control schools with existing differences in the teaching ability of the various instructors. The Minnesota Teacher Attitude Inventory and a measure of teacher's knowledge of the subject matter taught were obtained. The average scores for these measures indicated the control instructors rated higher on both of these measures. When these scores were used as covariates, it served only to reduce some of the existing differences in the post-test scores of students in the two groups.

All analyses conducted which compared the achievement of students on the post-tests in the treatment and control schools indicated that the students taught with the aid of single-concept films achieved no differently than did the students taught in the traditional manner. This held true in all four subject matter units. Since the four units were representative of the vocational agriculture instructional program, a generalization about the use of single-concept films in teaching vocational agriculture was
made. This generalization is that the vocational agriculture students taught with the aid of single-concept films achieved as well as students taught the same subject matter in a traditional manner.

A comment should be made about the four subject matter post-tests used to measure achievement. Although they were found to be reliable tests, they were never administered to students before they were used in this study. This was not the fault of the researcher. The lack of funds and time did not permit the administering of tests to appropriate subjects in advance of the conduction of the experiment. For this reason, the validity of each test was not established. Subject matter experts were, however, used to verify that the tests measured achievement in each unit of this study.

The use of 21 single-concept films in teaching the four units should also be discussed. This could very well have been an overuse of the media. Under ordinary circumstances, this number of films would not be available for use during a three-week period. The films were also not of equal quality. Some were understandably better than others. The films for the commercial fertilizer and farm credit unit were somewhat effected by the weather since filming did not begin until late fall. Most outdoor work with fertilizers had been completed and was not available for filming. The small gasoline engines unit possibly had the most suitable subject matter for filming since it was all completed under laboratory conditions. The animal health unit was not too adversely effected due to the fine cooperation received from the National Animal Disease Laboratory at Ames, Iowa.

The reproduction of the single-concept films in order to provide a set of films for each of the six treatment schools may have caused some
problems. Super 8 millimeter film loses a portion of its quality when it is reproduced. Some of the films reproduced better than others. The original films may have been more effective had they been used. What effect this had on the results was of course not measurable in this study.

The instructors in the six treatment schools may also have been at somewhat of a disadvantage when teaching with a media which they had not used before. Their lack of complete awareness and familiarity of the equipment and potentials of single-concept films could have hindered their teaching ability at the beginning until they became familiar and relaxed with this media. The instructors were only trained in the mechanics of using the films and equipment and did not have an opportunity to use single-concept films in teaching before the experiment began.

More learning may also have occurred if the media could have been used by the students in individual study. Since there was a treatment using audio-tutorial methods in the complete project, the films used were designed to be instructor narrated while used as an instructional aid in teaching specified subject matter. It is understandable that there are other ways of using single-concept films, but this study was limited to the use described above.

The characteristics of the individual students who performed best on the post-test of each subject matter unit were very similar for the treatment and control schools. The same type of students who achieved well when taught in a traditional manner did well when taught with single-concept films. These were students with high pre-test, intelligence quotient, Differential Aptitude Test (Verbal section), and agriculture achievement test scores.
The correlations for these variables with the specific objectives post-test scores were greater than .5000 for all but the small gasoline engines unit. In this unit the students in the control group had scores on the Mechanical section of the Differential Aptitude Test which correlated quite highly (.5021) with the specific objectives post-test scores. The same correlation for the students in the small gasoline engines unit in the treatment schools was .4119. In this unit the more academically associated variables seemed to be more highly correlated with the post-tests for the students in the treatment rather than in the control group. The correlation for intelligence quotient was only .3005 for the students in the control schools, whereas it was .4620 for the students in the treatment schools. Pre-test and agriculture achievement scores had correlations with the post-test scores of .4282 and .4453 for the control schools as compared to .4358 and .5749 for students in the treatment schools.

The correlations for the students taught with single-concept films seemed to indicate that the more academically inclined students performed best when taught with the films. This seems to parallel results from other media studies which conclude that no matter how students are taught, the highest achievers are generally those students with the most ability.

Since there was a feeling that the schools and/or instructors may have caused some variation in students' post-test scores, the effect that the schools had on post-test scores was also measured in this study. This was calculated for both the treatment and control schools. A regression analyses format was used to measure the variation in students' post-test scores that was associated with variations in schools. Dummy variables representing schools were used to remove this variation from the data, and the
contribution of these variables was analyzed.

The treatment schools and/or instructors of these schools were found to contribute significantly to the prediction of post-test scores in all but the farm credit unit. In this unit, the terms identifying schools were not important in accounting for post-test score variation. It is possible that the school effect in the three units may have come largely from variations in instructor influence on students in the particular subject matter units.

The existing variation from school to school could also have been due to factors other than the instructors. The general student atmosphere in a particular school during the three-week period could have greatly influenced results. The community in which one treatment school was located was seriously threatened by possible flooding during the experiment. Students did spend some time building dikes to save the town from flooding. Such uncontrollable factors no doubt had an effect on students' performance. How much effect could not of course be measured. Other school effects unaware of the researcher may also have influenced students' scores found in schools.

When the regression analysis used to determine the contribution of the control schools in predicting students' post-test scores was computed, only the farm credit unit indicated that school identification was important in accounting for student post-test score variation. The animal health, commercial fertilizer, and small gasoline engines subject matter units did not show variations in scores due to differences in schools important in predicting students' post-test scores.

For some reason the classes within the treatment and control groups
reacted differently when the four units were taught. The variation from school to school was great in some cases and negligible in others. Three of the four classes within the treatment schools were different, whereas only one of the control classes was different. How could these contrasting results be explained?

As mentioned earlier, the fact that the instructors in the treatment group were using unfamiliar media in teaching may have effected their ability to teach. Some instructors may have performed better using the films while others may have been hindered by the use of the media. Since the human factor was involved in this study, the instructors may not have reacted the same in all instances. For this reason, there still was some variation from instructor to instructor that could not be controlled. A different sampling technique may have better equated the instructors in the treatment and control groups.

A study conducted by Tindall (22) involving the same instructors as found in the treatment schools of this study indicated that such factors as instructor's education, experience, and tenure may have had an effect on students' achievement. Tindall also felt that there could be a relationship between student achievement and class size. The control schools had a total enrollment of 235 students, whereas the treatment schools contained 327 students. The instructors of the control group had considerably smaller classes with which to work. Such factors were not controlled when the instructors were assigned to the various groups. This possibly should have been considered.

There should be further studies conducted where the use of single-
concept films in teaching vocational agriculture are analyzed. Studies similar to the one conducted could be repeated using other subject matter units, different single-concept films, and different instructors. If such studies could be designed with concentration on control of instructor variation, a more accurate interpretation of the use of single-concept films in teaching could be obtained. Further study is also needed using single-concept films in different ways. By using them in both individual and group instruction, more could be learned about their potential in teaching vocational agriculture. The study of various types of single-concept films as defined by Scourzo (19) in the review chapter would also be of interest.

There is definitely a problem inherent to the use of single-concept films in vocational agriculture that must be overcome before this media will become common in vocational agriculture classroom use. Suitable projection equipment is available today for easy classroom use. Vocational agriculture instructors' awareness of the potentials of single-concept films has been increased as a result of this study. The one thing lacking which has greatly hindered the increased use of this media is the lack of available single-concept films. Until this problem is solved, the use of this media will not be widespread in the teaching of vocational agriculture.

Some leaders in vocational agriculture recommend that vocational agriculture instructors produce their own films. They feel that this would solve the problem of lack of suitable single-concept films for instructional purposes. There are a number of reasons why instructors have not undertaken this task. Reasons generally heard are that instructors feel they lack the competence required to produce the films, they feel they lack the
time required to make them, and schools often lack a sufficient budget to purchase equipment necessary to produce single-concept films.

It appears that there may be a need for instructional media centers on a regional bases throughout the United States which could produce and supply appropriate single-concept films to vocational agriculture instructors. Provision should be made to insure that the single-concept films found in one region would also be available in other regions if the need arose. Such a system would greatly enhance the use of single-concept films in teaching vocational agriculture.
A project which experimentally evaluated the effectiveness of various resources and techniques used in teaching vocational agriculture was conducted in 48 randomly selected Iowa high schools offering approved four-year vocational agriculture programs. This study was designed to be one of a series of studies originating from the larger project which was basically 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. This study dealt specifically with the use of single-concept films as instructional aids in teaching vocational agriculture.

Uniform teaching outlines and reference materials for the four specific subject matter units of animal health, commercial fertilizer, small gasoline engines, and farm credit were provided to each instructor in the study. This procedure was followed to help insure as much instructional uniformity as possible throughout all schools.

Of the 48 schools in the entire project, this study was concerned with six schools which were randomly assigned to the single-concept film treatment group and six schools randomly assigned to the control group. Twenty-one single-concept films were produced which were used in teaching the specific units in the treatment schools. The control schools taught the same units without the aid of the films.

Data were gathered on students prior to the beginning of the three-week experiment. The following tests were administered by the high school guidance counselors:
1. Otis Quick-Scoring Mental Ability Tests,
2. Kuder General Interest Survey,
3. Nebraska Agriculture Achievement Test,
4. Differential Aptitude Test (Mechanical, Abstract, and Verbal sections), and
5. Pre-test.

Since the schools were randomly assigned to the treatment or control groups, the classes within these schools were the experimental units on which most of the data were recorded. Students' scores on the above tests in each class were averaged. These means provided the measurements used in part of the analyses of the data.

Possible variations due to teacher differences from school to school were also of concern in this study. It was felt that students' scores may have been effected by the teaching ability of the instructors. For that reason, measurements were attained on the instructors which were used as covariates for adjusting students' post-test scores. The Minnesota Teacher Attitude Inventory test and the instructor's knowledge of the specific subject matter taught as measured by Beane (3), in a study of the same instructors involved in this study, were utilized.

The dependent variable used for all analyses was the post-test which was given immediately following the three-week unit of instruction. Since all instruction during this time period could not be taught with the aid of single-concept films, specific questions pertaining to the teaching objectives taught with the aid of the films were identified from the complete test in each subject matter unit. These questions were scored separately and the resulting scores were used for the basic analyses for each unit.
It was hoped that these results would give a more accurate interpretation of the effectiveness of single-concept films. This may have reduced the influence of extraneous variables which possibly had an effect when the films were not used as the primary source of instructional aid. The results from these tests were referred to as the specific objectives test results and most findings presented in this study are directly related to them.

Three types of analyses were performed on the data collected in this study. They were designed to find answers to the following two objectives:

1. To determine the effectiveness of single-concept films as an instructional aid in teaching vocational agriculture.
2. To determine selected interest and ability characteristics of students who achieve best when taught with the aid of single-concept films.

The analyses performed included:

1. Analyzing the mean pre- and post-test scores for the treatment and control schools using a two factor experiment involving repeated measures.
2. Using analysis of covariance to analyze differences between the adjusted post-test scores of the treatment and control schools.
3. Using correlations and regression analyses on individual student scores to determine which factors influenced most the post-test scores of students.

It was established that the treatment and control schools were not significantly different on their mean pre-test scores in the four subject matter units. Observation of these statistically nonsignificant pre-test scores revealed that the control schools did have somewhat higher mean
scores in all but the small gasoline engines unit.

One result that was obtained from the two factor experiment using repeated measures was that it compared the magnitude of change in knowledge from the pre-test to the post-test scores for the four subject matter units taught in the treatment and control schools. The magnitude of change was not significantly different in the commercial fertilizer, small gasoline engines, and the farm credit units. Although the control schools had higher post-test scores, the change in knowledge from the pre-test to the post-test was not greater (statistically significant) for the control schools. This did not hold true for the animal health unit. Here the magnitude of change was found to be significant. A closer look at the post-test scores for this unit revealed that the control schools had a greater increase in scores from pre- to post-test than did the treatment schools.

When single-classification analysis of variance was computed on the post-test scores of the treatment and control schools, the computed F values approached significance in favor of the control schools in all subject matter units. The fact that the control schools achieved greater post-test scores in all units had an effect on the results obtained from the analyses of covariance computations which were performed next.

Although the students and instructors in the control schools consistently outperformed the students and instructors in the treatment schools on all independent variables used as covariates, the adjusting factor from these variables was not sufficient to overcome the initial post-test score advantages of the control schools. The covariance analyses were at best only able to provide adjusted post-test means for the treatment schools which were slightly higher than those found for the control schools. After
adjustment, the initial significance in favor of the control schools was generally only slight if any in all units.

The student variables which tended to have the greatest adjustment effect on post-test scores were those of pre-test, intelligence quotient, and agriculture achievement test scores. Where the variables obtained on instructors were used as covariates (Minnesota Teacher Attitude Inventory and instructor's knowledge of the subject matter), little effect on adjustment of student post-test scores was shown.

In all analyses which compared the performance of the schools whose students were taught with the aid of single-concept films with the performance of the students in the control group schools, no significant differences were found in achievement of the two groups. Vocational agriculture students seemed to achieve no differently when taught with single-concept films as when taught similar subject matter in a traditional manner.

Correlations computed between student scores on specific independent variables and the post-test scores were found to be only slightly different for the students in the treatment and control schools. In both groups the variables of pre-test, intelligence quotient, Differential Aptitude Test (Verbal section), and agriculture achievement test scores had correlations greater than .5000 with post-test scores for the animal health, commercial fertilizer, and farm credit units.

Neither group had very high correlations in the small gasoline engines unit. The correlations for this unit did vary somewhat for the two groups. The agriculture achievement and the Abstract section of the Differential Aptitude Test had the highest correlations for the treatment group. The Mechanical and Abstract sections of the Differential Aptitude Test had the
higher correlations for the control schools. The general conclusion was made that there did not seem to be much difference between the treatment and control group in selected interest and ability characteristics of the students in the four subject matter units who performed best on the post-tests.

All regression models for the students in the treatment and control groups using the independent variables of pre-test, intelligence quotient, Differential Aptitude Test (Mechanical, Abstract, and Verbal sections), agriculture achievement, and Kuder General Interest Survey (Outdoor section) test scores along with dummy variables designed to account for any differences existing from school to school were found to significantly predict post-test scores. The results from the specific objectives and the overall subject matter post-tests were basically the same for the four units. The models accounted for a major portion of the existing variation in the post-test scores as measured by the large multiple $R^2$ values for each unit.

The greatest difference between the treatment and control schools was found when analyses were computed which were designed to determine if the loss due to elimination of the dummy variables representing schools was significant when removed from the full model. The individual school effect was great enough in the animal health, commercial fertilizer, and small gasoline engines units taught with the aid of single-concept films that the dummy variables representing schools could not be removed from the model. The dummy variables accounted for a significant amount of variation existing in the post-test scores. It was shown that the model could exclude the school terms in the treatment classes taught the farm credit unit when using the specific objectives post-test as the dependent variable. The
overall test results did find the school identification important for this unit.

Contrasting results were found for the control schools. Here the dummy variables could be dropped from the full model of the animal health, commercial fertilizer, and small gasoline engines units. The schools or teachers did not seem to affect the students' achievement in the respective schools. Results from the farm credit unit revealed that the schools and/or teachers did affect achievement from school to school and could not be dropped from the model.

The results of this study could be condensed into the following summary statements:

1. The students in the treatment and control schools were quite similar in prior knowledge of the subject matter before the three-week 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 objectives test results were basically no different than the overall subject matter tests.

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 agriculture 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 variables used in predicting post-test scores accounted for a large amount of the 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 schools 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.

It appears that single-concept films can be used in teaching vocational agriculture students. There are times when the addition of motion to a classroom presentation would be very advantageous. It is not always possible to take students to a live example of the subject the instructor is discussing nor is it always possible to bring the live subject to the students. Single-concept films seem to be one source of media which can serve this purpose.

The mechanics involved in showing motion through the film media has been reduced greatly due to recent advancements in technology. As more and more single-concept films become available to vocational agriculture
instructors, the instructors will no doubt find their use advantageous in teaching.
LITERATURE CITED


Grateful appreciation is expressed to Professor Clarence E. Bundy for his assistance, encouragement, and guidance in preparing this dissertation.

Special recognition is given to the many people who have contributed to the successful completion of this study. Major acknowledgment is made to the other members of my graduate committee: Dr. Thomas A. Hoerner, Dr. Trevor G. Howe, Dr. Alan A. Kahler, and Dr. Richard D. Warren.

This study could not have been completed without the funds received through a research grant from the Iowa Department of Public Instruction, Division of Vocational Education from Ancillary funds provided by the Vocational Education Act of 1963.

A special appreciation is extended to my wife, Toni, for her patience, understanding, and assistance during the course of this study.
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

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
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
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   3. Sore Mouth   5. Lambing

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   5. Stomach Worm
2. Lice   6. Tapeworms
3. Ticks   7. Coccidiosis
4. Scabbedies
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
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
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
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 phosphorus 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 deficiencies
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)
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
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
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

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, Corp., p. 4
b. Small Gasoline Engines Student Handbook, Penn. State Univ. p. 4
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:

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:


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
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

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
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:


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
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
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
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
The annual death toll from diseases in the U. S. is: swine 15%, cattle 10%, and sheep 20%. This results in a $2 billion loss each year.

How can this be prevented? You must be able to recognize healthy animals and conditions.

Characteristics of healthy animals are:

1. Posture - the animal stands erect with a calm disposition. The animal is alert.
2. Movement - this animal could not be too sick!
3. Voice - animal sounds can mean a lot. Sounds of content, pain, and anger are some.
4. Appetite - animals that eat usually are not too sick.

Some keys to animal health that you should look for are:

1. Be alert - a good livestock man spends time among his animals looking for signs of possible problems.
2. Diagnose problems - call the veterinarian for proper diagnosis if something looks wrong.
4. Ventilation - in order for an animal to be healthy, he needs to have well ventilated housing which provides fresh air.
5. Sanitation - keep animals dry and clean.
6. Well-balanced feed - feed a well balanced feed.
7. Buy disease free stock - isolate all new livestock that is brought on the farm. This helps prevent spread of diseases to your herd.
8. Remove dead animals as fast as possible.

If you can keep your animals healthy, then you will put extra dollars in your pocket.

The key to profit is keeping your livestock healthy.
CATTLE GRUBS

Frame Reference: Script:

Title

Cattle Grubs
Cattle grubs are also known as warbles. The cattle grub is the larval stage of the heel fly. It damages the carcass and the hide of the animals.

Cattle in feedyard

Many cattle are infested with grubs but the farmer is often not aware of the infestation. The symptoms are a swelling or lump under the hide in the back. In central Iowa this is usually found from December to May.

*Uninfested carcasses

The carcass of an uninfested animal will look clear and unblemished as these. The meat buyers are looking for this type of carcass and will go where they can find it.

Infested carcass

The grubs and surrounding tissue were trimmed from these carcasses to pass government inspection. Grubby carcasses often sell for $25 less and cost the packer more for the labor of trimming.

Heel fly

The heel fly is seldom seen but cattle bolting in the spring and early summer are often running from this fly.

Grub

The grub punctures a breathing hole in the skin of the animal. It causes a decrease in milk production, slower gains, and damage to the hide and meat of the animal.

Life cycle

There are 4 stages in the life cycle of the grub. By understanding these stages one can know when to apply a treatment to control the grub.

*1. Heel fly lays eggs

The heel fly lays its eggs on the hairs by the heel of the cattle in the spring or early summer. The heel fly lives only a few days. The eggs hatch into larvae in a few days. The larvae burrow through the skin and migrate to the back of the animal where they chew a breathing hole through the skin. This migration may take 9 months. The larvae grow and become the familiar bump on the animals back.

*2. Larvae move to back

In 6 to 8 weeks the larvae emerge through the hole in the animals back, drop to the ground, and pupate under trash.
### Pupa emerge as adult fly

The adult fly emerges in the spring and lives for only a few days. It has no stinger or biting part but simply glues its eggs to the hair of the animal.

*(Hold the film on "still frame" at these points the first time it is shown to the student to allow time for explaining the material.)*

<table>
<thead>
<tr>
<th>Method</th>
<th>Explanation and Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spray or pour on</td>
<td>Cattle grubs may be controlled by spraying or pouring an insecticide on the back of the animal. Cattle shipped into Iowa from Missouri, Kansas and further south should be treated before September 1. Local cattle should be treated after August 15 and before November 1.</td>
</tr>
<tr>
<td>Feed additive</td>
<td>Cattle can also be treated by mixing a systemic with the grain ration and feeding it for 7, 10 or 14 days, depending on the brand used.</td>
</tr>
<tr>
<td>Spraying cattle</td>
<td>Cattle should be sprayed with a pressure of 350 pounds per square inch and one gallon per head. Only 8 to 10 cattle should be sprayed at one time.</td>
</tr>
<tr>
<td>Spray with</td>
<td>The three insecticides currently on the market for spraying grubs are: 1. Co-Ral 2. Neguvon 3. Ruelene</td>
</tr>
<tr>
<td>Pouring on cattle</td>
<td>A long handled dipper may be used to pour the insecticide on the animal's back. This method is fast, wastes no chemical and results in excellent grub control.</td>
</tr>
<tr>
<td>Pour-on</td>
<td>Four products currently available for pour-on applications are: 1. Co-Ral 2. Famfur (or Warbex) 3. Neguvon 4. Ruelene</td>
</tr>
<tr>
<td>Mixing the feed</td>
<td>A systemic can also be mixed in the cattle feed. This doesn't require sprays or spray equipment. But it is a little more expensive than spraying.</td>
</tr>
<tr>
<td>Feeding in bunk and cattle eating</td>
<td>This material is fed to the cattle for 7, 10 or 14 days depending on which of the materials was chosen.</td>
</tr>
<tr>
<td>Feed Ronnel</td>
<td>Ronnel is the active ingredient in the following feed additives: 1. Rid-Ezy 2. Steer-Kleer 3. Trolene</td>
</tr>
</tbody>
</table>
Cattle Stomach Worms

The various stomach worms are the greatest menace of all internal cattle parasites. They do their greatest damage in the young cattle.

There are four stages in the life cycle of the cattle stomach worm. By understanding these stages one can know when to apply a treatment to control the parasite.

1. Eggs laid in digestive tract

   The adult worm in the digestive tract of cattle lays eggs.

2. Eggs passed out in feces

   The eggs are eliminated from the body with the feces where they hatch on the ground and crawl upon a blade of grass.

3. Cattle eat larvae on infested grass

   The cattle eat the infested grasses while grazing.

4. Larvae develop in digestive tract

   The larvae develop into adults in the digestive tract of the cattle and lay more eggs.

Stomach worms can be controlled by several methods. One is to rotate the pastures so the larvae will die when no host is available.

Cattle can be dewormed with commercial wormers applied in one of three methods.

The wormer may be administered as a liquid with a syringe. The syringe is a tubular tool holding enough material to drench an animal.

When preparing to drench an animal the first step is to firmly restrain the animal. Then mix and prepare the wormer. Grab the animal under the chin with the left hand and place the syringe well back in the throat. Expel the material from the syringe and hold the animal until it swallows.

A balling gun uses a large pill-like bolus of the wormer.

When using a balling gun hold the animal as for drenching and administer the bolus in the same manner.
Feed additive | Cattle may also be wormed with the use of a feed additive.
Mixing the feed additive | The feed additive is mixed thoroughly with the feed.
Feeding | The feed containing the feed additive is given to the cattle at a regular feeding time. It is a little more expensive than drenching or balling.
Phenothiazine | Two materials are usually recommended for worming. Phenothiazine, which must be mixed well before use.
Thiabendazole | Thiabendazole, commonly called Thiabenzole, must also be mixed.
Phenothiazine feed additive | Phenothiazine is also available as a feed additive.
DEWORMING OF SHEEP

<table>
<thead>
<tr>
<th>Frame Reference</th>
<th>Script:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Deworming of Sheep</td>
</tr>
<tr>
<td>Mixing chemicals</td>
<td>Most of the materials for deworming sheep must be mixed thoroughly before using.</td>
</tr>
<tr>
<td>Pouring into cup</td>
<td>Pour the mixture into a container where it can be taken with a syringe.</td>
</tr>
<tr>
<td>Catching sheep</td>
<td>Confine the sheep in a small area where they can be easily caught. Catch the sheep by the folds of the skin, not by the wool. Then stand over the animal holding the neck with your legs.</td>
</tr>
<tr>
<td>Administering drench</td>
<td>Hold the jaw with the left hand, put the drenching gun in the corner of the mouth, administer the drench, and be certain that the animal swallows the material.</td>
</tr>
<tr>
<td>Marking head</td>
<td>Mark the animals to indicate which ones have been treated.</td>
</tr>
<tr>
<td>Dosage syringes</td>
<td>Sheep are usually drenched with syringes such as these.</td>
</tr>
<tr>
<td>Materials</td>
<td>Materials to use for drenching sheep could be: 1. Thibenzoic in either liquid or powder form, 2. Phenazoid in liquid form, 3. Teniazine liquid (shake well as you would with the other liquids), and 4. Phenothiazine.</td>
</tr>
<tr>
<td>Balling gun</td>
<td>Boluses of the materials for deworming could also be administered with the balling gun instead of using a drench.</td>
</tr>
</tbody>
</table>
HOG CHOLERA

Frame Reference:  Script:
Title  Hog Cholera
Cause  Hog Cholera is caused by a virus so small that it cannot be seen except with very special microscopes.
Pigs eating  To show the affect of the disease, five healthy pigs, as you can see by their eating habits, will be injected with Hog Cholera in order to see what affect it can have.
Injection  The veterinarian fills his syringe, disinfects the area to be shot, and injects the live hog cholera virus.
Symptoms  We will pick out the symptoms as they occur.
Day four  At four days the most noticable symptoms are loss of appetite and lack of alertness from the pigs.
Day seven  At seven days the disease is much more noticeable. The pigs hind quarters become stiff and weak. These pigs are feverous and have gone completely off feed. They have temperatures of about 107 degrees with normal being 101. They do not care to eat and have a hard time moving around. At this stage they huddle together as much as possible. If there were bedding to crawl under, they would have done this.
Day eleven  On the 10th day two of the pigs died. On the 11th day one more was dead and the remaining two were pretty sick. The pigs cannot move around, they have a high fever, and just lay there and shake.
Pigs ear  An outward symptom is the purple discoloration of the edge of the ear and sometimes the bellies and ham section.
When one of the pigs is helped up, it just cannot make it. This is a terrible disease that has wiped out complete herds when the disease is contacted.
Treatment  There is no treatment for Cholera once it is contacted.
Prevention  Vaccination is no longer available from veterinarians today. Prevention today means complete eradication of the disease by a four-phase program established by Congress in 1961. (After the film is over go through the eradication program described in the Animal Health booklet.)
Atrophic Rhinitis

At no one knows exactly what it is that causes this disease. It is a disease which is spread from hog to hog through infected feed, water, and body contact.

Atrophic Rhinitis is a disease that effects the nose of a pig.

This first pig is a normal pig. Its nose is straight and in this case pretty long. The organism which causes Atrophic Rhinitis causes the inside of the nose to degenerate or disappear. The nose loses its structure and becomes distorted.

This pig's nose is somewhat bent to one side. You can see that the disease does not affect the appetite of the hog, but it does cause unthriftiness which means a long time to market and less profit.

This pig's nose has lost its inside support and has pulled back. The nose has wrinkles and is bulging like a Berkshire.

This was what the normal pig should look like. If you look inside the noses of these pigs you could tell why they look the way they do.

This is the inside of a nose of a normal pig. The nose has been cut in half to show what the inside should look like. Note the butterfly shaped part.

Next is a nose of a pig which has a mild case. The lower portion of the butterfly shaped area is disappearing.

A pig with a moderate case of Atrophic Rhinitis has lost a larger portion of the area that gives a pig's nose the shape it should have.

The severe cases look like this. What was a butterfly-shaped area before has completely disappeared. With the loss of this area, the nose may become twisted and pull back.

There is no treatment for this disease mainly because the exact cause is still not known.

Prevention should be practiced. If the disease is contacted, sell all pigs and disinfect thoroughly before bringing clean stock back on the farm.
There are common sites throughout Iowa today that were not there a few years ago. The fertilizer industry has greatly expanded. The use of fertilizers is a big business today. In order for the farmer to keep up he must know all that there is to know about fertilizers to make maximum profits.

Fertilizer use in Iowa has increased over 150% from 1960 to 1968.

The use of nitrogen alone has increased over 330% from 1960 to 1968.

Today over 90% of Iowa's corn acres are fertilized.

This has been the primary reason for the increase in average corn yield in Iowa from 62 bushels per acre in 1960 to over 90 bushels per acre in 1968.

What has this meant to the farmer? This increased yield has meant a rapid advancement in technology that he must keep up with or be left behind.
HOW TO TAKE A GOOD SOIL SAMPLE

Frame Reference: Script:
Title How To Take a Good Soil Sample
Farmer studying field With the help of a soil map, study the field that is to sampled.
The area that is to make up a soil sample should be marked off and identified.
(The first time through the film turn off the projector and explain how a field would be separated into areas of similar soils for uniform sampling. At this time also explain the type of tools which can be used for soil sampling. Mention the probe, auger, shovel, and trowel. We will use the probe in this film.)
Clearing away debris Before taking a sample, all debris should be cleared away.
Probing The probe should go about 6 inches into the ground. Dump each probe taken into a pail.
Another probe Fifteen to twenty such probes should be taken at random locations throughout the area to be sampled.
Mixing Mix these individual probes together thoroughly.
Mark sample bag Correctly mark the soil sample bag to correspond to the soil sampling map.
(The first time through the film turn off the projector and explain in detail how the sampling bag should be marked so that accurate identification can later be made.)
Fill bag Fill the sample bag to the appropriate level and seal.
Clean pail Dump the remaining sample from the pail and clean it out before taking a new sample.
Information sheet Complete a soil and cropping information sheet and include this with the soil samples when they are sent to the soil testing laboratory.
(At the end of the film stress that the following areas should be avoided when taking a soil sample: dead furrows, backfurrows, old fencelines, old straw or haystack bottoms, field depressions, areas where dust from a road may land, and gateways.)
Frame Reference: Script:
Title Soil Testing Laboratory
Receiving sample The soil sample that was sent in is received by the soil testing laboratory. Each individual sample is given a laboratory identification number.
Screening The samples in their field condition are screened. This further mixes the individual samples and removes all debris.
Weighing One hundred grams of soil from the sample is weighed out and 200 milliliters of water is added.
Subsample Subsamples are then taken from the mixing cylinders for the pH test, the phosphorus test, and the potassium test.
pH test First a buffer solution is added. The pH is read from this solution and the reading is recorded. This sample had a pH of a little over 6.
Phosphorus test A solution which extracts the phosphorus from the soil is added to the soil solution. The solution is shaken for five minutes, then filtered, and a reagent added to the filtrate. This reagent turns the filtrate to a color of blue depending on the amount of phosphorus in the sample. The intensity of the color if blue is read and this is recorded as the pounds per acre of phosphorus in the soil sample.
Potassium test A solution is added to the soil sample which draws out the potassium. The mixture is shaken and filtered. A portion of the filtrate is burned and the color of the flame produced indicates the actual amount of potassium in the soil sample. This is recorded.
Punching These lab results are then transferred onto data cards along with the information sent in on the soil and cropping information sheet.
Printouts This is fed into a computer which prints out the results that are mailed back to you.

(At the end of the film, go to the printout sheets provided and continue your class presentation from here. The film should serve as an introduction to interpreting the soil sample results.)
Frame Reference: Selecting Fertilizers to Fill Nutrient Needs

Title

Background information 1. There was corn planted in the field last year.
2. There is to be corn planted this year.
3. The farmer wishes to fertilize at a high nutrient rate.

Nutrient requirements The nutrient requirements from a soil test report indicates that 160 pounds of nitrogen needs to be added per acre, 60 pounds of phosphorus, and 40 pounds of potassium.

Carryover Carryover from 80 pounds of actual nitrogen applied per acre last year on corn is 20 pounds per acre of nitrogen credit.

(Stop the projector and go to Table 2 on page 3 of Understanding Your Soil Test Report and determine how this figure was arrived.)

Fertilizer needs What needs to be applied? We needed 160 pounds of N, 60 pounds of P₂O₅, and 40 pounds of K₂O. There was 20 pounds of N credit. This means that we still need to apply 140 pounds of nitrogen per acre, 60 pounds of phosphorus, and 40 pounds of potassium.

Meeting needs How can these needs be met? Two examples will be given.

First example:

Meeting nutrient needs

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Lbs. per acre</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter</td>
<td>5-20-20</td>
<td>100</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Flow down</td>
<td>0-20-10</td>
<td>200</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Sidedress Anhydrous Ammonia</td>
<td>165</td>
<td>135</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Applied</td>
<td></td>
<td>140</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Total Needed</td>
<td></td>
<td>140</td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>
SELECTING FERTILIZERS TO FILL NUTRIENT NEEDS (continued)

Second example:

Meeting nutrient needs

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Lbs. per acre</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plow down</td>
<td>0-15-10</td>
<td>400</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>Sidedress</td>
<td>82% Anhydrous Ammonia</td>
<td>171</td>
<td>140</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Total Applied</td>
<td>140</td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>

(Classroom explanation will have to be used to point out where these figures came from and why they were selected. It is important to know that other combinations could just as well have been used depending on the cost and ease of application of various types of fertilizers.)
Frame Reference: Script:
Title
Four functions
2-cycle engine
Compression
Arrow in crankcase
Reed valve
Power
Ports closed
Crankcase
Exhaust
Intake
Compression

Operating Principles of the 2-cycle Engine

There are four functions that take place. They are:
1. power
2. exhaust
3. intake
4. compression

This is an illustration of what a 2-cycle engine looks like and how it functions.

During compression the gases in the cylinder are forced into a small area. Both the intake and exhaust ports are closed. As the piston moves up, the gases are compressed.

As the piston goes up, a vacuum or low pressure is produced in the crankcase.

This allows the reed valve to open and new air-fuel mixture enters from the carburetor.

During the power stroke the air-fuel mixture in the cylinder is ignited by the spark plug and this forces the piston down.

The intake and exhaust ports are still closed during the power stroke.

This increased pressure in the crankcase forces the reed valve to close.

During exhaust the exhaust port is open and the burned gases are expelled.

The intake port is uncovered during intake. The compressed air-fuel mixture in the crankcase rushes into the cylinder area. A curved device projects the incoming gases up which serves to remove the remaining burned gases from the cylinder.

The momentum of the flywheel forces the piston up for the compression stroke.

(Repeat the four functions as they occur on the moving piston at the end of the film.)
Frame Reference: Script:
Title Operating Principles of the 4−cycle Engine
Functions The 4−cycle engine has the same functions or strokes as the 2−cycle engine. They are intake, compression, power, and exhaust.
4−cycle engine The physical appearance of the 4−cycle engine is somewhat different than the 2−cycle engine. It performs the same task, but in somewhat a different manner. (Stress similarities and differences between the two types of engines.)
Intake As the piston goes down it creates a vacuum in the cylinder. The intake port is opened and the air−fuel mixture from the carburetor rushes in.
Compression The intake port closes as the piston moves up. This compresses the gas mixture in the cylinder.
Power Just before the piston reaches the top, the spark plug fires igniting the gas mixture. This forces the piston down on its power stroke.
Exhaust As the piston moves up from the momentum of the power stroke, the exhaust port opens allowing the burnt gases to escape. This completes the four functions in 4 strokes of the piston rather than 2 as in the 2−cycle engine.

(The next few frames will show a continuous movement of the piston indicating the four strokes. You can point these out as they occur on the screen.)
<table>
<thead>
<tr>
<th>Frame Reference:</th>
<th>Script:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Parts of a Micrometer</td>
</tr>
<tr>
<td>Micrometer</td>
<td>This is an instrument designed to measure in thousandths of an inch.</td>
</tr>
<tr>
<td>Frame</td>
<td>The frame is used to hold onto the micrometer when making a measurement.</td>
</tr>
<tr>
<td>Rachet</td>
<td>The very fine measuring capabilities of the micrometer are protected by the rachet.</td>
</tr>
<tr>
<td>Thimble</td>
<td>The thimble is divided into 25 parts. Each one is equal to .001 inch.</td>
</tr>
<tr>
<td>Sleeve</td>
<td>The sleeve is divided into 40 lines. Each one is equal to .025 inch.</td>
</tr>
<tr>
<td>Spindle</td>
<td>The spindle and the anvil provide the ends for the measuring surface which is the area where the object to be measured is placed.</td>
</tr>
<tr>
<td>Spindle screw</td>
<td>The spindle screw is a series of 40 threads included in one inch of the spindle.</td>
</tr>
<tr>
<td>Forty threads</td>
<td>These forty threads correspond to the forty lines on the sleeve. Each one is 1/40 of an inch or in decimal form this would be .025 inches. These forty lines are included in 10 numbers each equal to .1 of an inch.</td>
</tr>
<tr>
<td>Thimble</td>
<td>The thimble consists of 25 lines with each one equal to .001 inch. One rotation of the thimble covers .025 inch or one line on the sleeve.</td>
</tr>
</tbody>
</table>
Frame Reference: Script:

Title
Reading the Micrometer

Measuring
The measurement is made by finding the position where the micrometer will loosely move on the object being measured.

Number gradation
Determine the largest number gradation showing on the sleeve. In our case it is an 8.

Micrometer
When making a measurement, first identify what type of micrometer you are using. This was a one inch micrometer meaning that it makes measurements up to one inch. Therefore, we begin with .000 for the micrometer.

Sleeve
We next add on the .800 from the sleeve.

Line
Next determine which line between the number 8 and 9 can be seen. In our case there are 3 lines visible. Write down .075. (Stop the machine to better point this out. The three lines become more noticeable.)

Thimble
The last step is to read the number on the thimble and record this. We have a reading of 2. (You will notice that this is in error. It should be three. The example should have been more exact. The next example will be better.)

Total
Total these numbers together and our micrometer reading is .877 inches.

Second example
Another example is shown using a 2 inch micrometer. This micrometer will make measurements greater than one inch but not more than two inches. The reason for this is that there is only one inch of threads that can be used for measuring so that the numbers and lines are similar on all micrometers.

Sleeve
The largest number visible on the sleeve is five.

Writing
After writing one inch for the type of micrometer that we have, we add on the number on the sleeve which was .500.

Line
Next determine what line between numbers on the sleeve is visible and add this on. We have one line visible between 5 and 6 so we add on .025.

Thimble
The final measurement to add on is the nearest number on the thimble. This is 11 in our example so we add on .011.

Total
Totaling these figures we have a measurement of 1.536.
Frame Reference: Script:
Title Operating Principles of Carburetors
Diagram This is a cutaway diagram of a carburetor.
Blue and red area The blue colored area indicates where there is air and the red colored area indicates where there is fuel.
Needle valve The needle valve controls the amount of fuel available to the carburetor.
Fuel bowl float The fuel bowl float maintains a constant fuel level in the fuel bowl.
Throttle The throttle controls the speed of the engine by controlling the amount of air-fuel mixture that enters the combustion chamber.
Choke plate The choke plate controls the air flow into the carburetor.
Idle valve The idle valve controls the amount of fuel available to the carburetor when the engine is at low speed or idling.
Venturi The venturi is a section of the carburetor which increases the air speed by forcing a given volume of air through a narrow passage.
Main jet discharge holes The main jet discharge holes are small openings which supply fuel to the carburetor from the fuel bowl.
Bleeding system The bleeding system adds air to the fuel when the engine is operating at high speed to obtain a better air-fuel mixture.

(The first time through this film the projector can be stopped to fully explain the starting system, the idle system, and the high speed system. Stop the projector when all the air and fuel arrows are in place.)
Starting system When starting the engine a rich air-fuel mixture is desired. This occurs when the choke plate is closed. The flow of air is restricted and a low air pressure at the venturi is created. The lower the pressure, the more fuel is forced into the system. The fuel is in about a 2 to 1 ratio to air.
Idle

When the engine is idling the throttle plate is almost closed which limits the amount of air-fuel mixture that goes to the combustion chamber. The air is forced through a restricted area next to the throttle plate. This causes a high pressure on one side of the plate and a low pressure on the other side of the plate. This pulls the fuel up through the idle valve and not through the discharge ports. Air actually enters the discharge ports and mixes with the fuel. The resulting small quantity of air-fuel mixture is in about a 1 to 1 ratio.

High speed system

At high speed both the choke plate and throttle plate are wide open. This permits a maximum amount of air and fuel to flow. A low pressure is created behind the venturi which pulls fuel from the discharge ports. The amount of fuel that could be drawn under the extreme low pressure is reduced by mixing air with the fuel through the bleeding system. The air-fuel mixture is in a 1 to 1 ratio and in large quantities.
<table>
<thead>
<tr>
<th>Frame Reference:</th>
<th>Script:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Parts of a Magneto Ignition System</td>
</tr>
<tr>
<td>Engine</td>
<td>This is a small gasoline engine with the flywheel and the head removed.</td>
</tr>
<tr>
<td>Magnet</td>
<td>There is a permanent magnet cast into the flywheel. This magnet is used to generate electricity which produces the spark at the spark plug. You can see that this magnet is quite strong.</td>
</tr>
<tr>
<td>Coil</td>
<td>With the help of the magnetic field from the magnet, the coil generates and transports electricity.</td>
</tr>
<tr>
<td>Armature</td>
<td>The armature is made up of strips of soft iron which serve to strengthen the magnetic field set up by the magnet.</td>
</tr>
<tr>
<td>Cut-away coil</td>
<td>A cut-away of a coil shows the armature around it. Note the wires leading from the coil. The primary winding is made up of about 175 turns of heavy wire. The secondary winding has about 10,000 turns of very small wire wrapped around the primary winding. This is about a 60 to 1 ratio. One lead from each the primary and secondary winding is grounded together. The other end of the primary winding leads to the breaker points. The other end of the secondary winding leads to the spark plug.</td>
</tr>
<tr>
<td>Condenser</td>
<td>The condenser acts as an electrical storage tank. It absorbs current when the breaker points open. This prevents a spark from arcing across the breaker points which would result in burned points and a faulty ignition system.</td>
</tr>
<tr>
<td>Breaker points</td>
<td>The breaker points are normally open on this system. They are closed and opened by the crankshaft. When the magnet begins to affect the coil, the points are closed so that electricity can flow. When the points open, the flow is stopped, the magnetic field collapses, and a spark is produced at the spark plug.</td>
</tr>
<tr>
<td>Primary circuit</td>
<td>The following parts make up the primary circuit: 1. primary winding, 2. breaker points, and 3. condenser.</td>
</tr>
</tbody>
</table>
Frame References: Secondary circuit

Script:
The following parts make up the secondary circuit:
1. secondary winding, and
2. spark plug.

Spark plug

The heavy wire leading from the coil (referred to as the high tension lead) is one end of the secondary winding and it connects to the spark plug. When the flow of current is stopped in the primary winding, voltage is induced into the secondary winding creating enough current to jump the spark plug gap and produce the spark needed for ignition. Note the spark produced.
MAGNETO IGNITION SYSTEM

<table>
<thead>
<tr>
<th>Frame Reference:</th>
<th>Script:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Magneto Ignition System</td>
</tr>
<tr>
<td>Function</td>
<td>Function: Produce a spark</td>
</tr>
<tr>
<td>Question</td>
<td>How is this accomplished?</td>
</tr>
</tbody>
</table>

Engine
Note the parts of the magneto ignition system which we saw on the previous film. Remember that the magnet in the flywheel is what causes electricity.

Flywheel
When the magnet is away from the coil, it has no affect. At this point the breaker points are open.
As the magnet approaches the coil, the coil begins to "feel" the magnet.
As the magnet lines up with the armature legs, the breaker points close and electricity begins to flow in the primary circuit.

Piston
Note the position of the piston in the cylinder at the time when the breaker points close. It is approaching top dead center.

Magnetic field
The magnet creates a magnetic field around the wires. The magnetic direction at this time is shown in this diagram, North to South.

(The first time through the film stop the projector on the colored diagram and explain it in more detail. Talk about the magnetic field and the flow of electricity in the primary circuit.)

Flywheel advances
As the flywheel advances, the effect of the magnet increases causing a greater flow of electricity in the primary circuit.

Flow of magnetic field
The magnetic field flows in a circular direction from the magnet through the armature and around the coil windings.

(The first time through the film stop the projector on the colored diagram and explain the magnetic flow in more detail.)

Primary circuit
The flow of electricity so far is taking place in the primary circuit only. The primary circuit consists of the:
1. primary winding of the coil,
2. breaker points which allow the current to flow when closed, and
3. the condenser which absorbs the current in the primary circuit when the points open.
(Stop the projector the first time through the film and explain this diagram in more detail.)

Frame Reference: Script:

Flywheel rotates
Note the position of the flywheel when the magnetic field is strongest in the primary winding. At this point the magnetic field flowing from the magnet through the armature and coil changes direction.

Points open
At the same instant the breaker points open causing the flow of electricity in the primary circuit to stop. The strong magnetic field around the primary winding collapses.

Secondary circuit
Now the secondary circuit comes into play. It consists of the secondary winding and the spark plug.

The collapsing magnetic field and the change in direction of flow of current greatly increases the amount of voltage in the system. Voltage in the primary circuit increases from approximately 10 to 200 volts. According to the ratio of the number of turns in the secondary and primary windings, the voltage in the secondary circuit increases from approximately 600 volts to 12,000 volts.

The high voltage, approximately 12,000 volts, in the secondary circuit has enough current flow to jump the spark plug gap resulting in the spark which ignites the air-fuel mixture in the cylinder.

(Stop the projector on the diagram of the secondary circuit to explain it more fully the first time through.)

Spark plug wire
Note the wire that leads from the secondary winding to the spark plug, usually referred to as the high tension lead.

Piston
Note that the piston has almost completely compressed the air-fuel mixture when the spark is produced.

It should be pointed out that there is only a very small amount of upward movement of the piston from the time the points close to the time they open producing the spark.
# HOW CAN CREDIT HELP ME IN FARMING?

<table>
<thead>
<tr>
<th>Frame Reference</th>
<th>Script:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>How can Credit Help Me in Farming?</td>
</tr>
<tr>
<td>Farming</td>
<td>Today farming requires: experience, knowledge, interest, courage, ambition, determination and savings. And most of all credit.</td>
</tr>
<tr>
<td>Use</td>
<td>The use of farm credit in Iowa has steadily increased over the years.</td>
</tr>
<tr>
<td>Non-real estate</td>
<td>Non-real estate farm loans. Examples of such loans are: buying feeder cattle, paying for chemicals, buying feeder pigs, and covering costs of corn production. Non-real estate farm loans have increased from $575,286,000 in 1962 to $1,107,706,000 in 1968. This has been a 93% increase.</td>
</tr>
<tr>
<td>Real estate</td>
<td>Real estate farm loans. This type of loan is usually used to purchase a farm. Real estate farm loans have increased from $879,027,000 in 1962 to $1,230,638,000 in 1968. This has been a 40% increase. You can see that farm credit plays a big role in today's agriculture.</td>
</tr>
<tr>
<td>Profit formula</td>
<td>It is hoped that this credit can be a major factor in increasing profit.</td>
</tr>
<tr>
<td>Profit</td>
<td>Profit is a result of capital, labor, and management. With the wise use of credit, these three factors can be brought to their maximum level.</td>
</tr>
<tr>
<td>Feeding set-up</td>
<td>A set-up such as this generally requires credit. This set-up has capital, maximizes labor output for an individual, and if management is adequate a profit should be shown.</td>
</tr>
<tr>
<td>Frame Reference:</td>
<td>Script:</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------</td>
</tr>
<tr>
<td>Title</td>
<td>Classifying Loan Requirements</td>
</tr>
<tr>
<td>Types of credit</td>
<td>There are three types of credit.</td>
</tr>
<tr>
<td>Short-term</td>
<td>The first one is short-term credit which can be subdivided into one of the following: 1. monthly (0-3 months) 2. seasonal (3-9 months) 3. annual (9-12 months) This means that this type of loan generally will not run more than a year in length.</td>
</tr>
<tr>
<td>Used for</td>
<td>Short-term loans can be used to purchase such things as: fertilizers, chemicals, covering costs in raising soybeans, an example of a seasonal type loan could be buying seed corn and not paying off the loan until harvest time (state this by showing pictures of seed corn, the field of corn, and the ears on the stalk), buying feeder pigs, or buying beef cattle.</td>
</tr>
<tr>
<td>Intermediate-term</td>
<td>The second type of credit is intermediate-term credit which usually runs from 1-5 years in length.</td>
</tr>
<tr>
<td>Used for</td>
<td>Intermediate-term credit can be used to purchase such things as: beef cows, a good bull, sows, dairy cattle, building a milking parlor, buying machinery such as tractors, disks, choppers, building a drying unit, buying a self-propelled combine, putting up a silo, or building a shed.</td>
</tr>
<tr>
<td>Long-term</td>
<td>The third type of credit is long-term credit. This credit lasts for more than five years and is generally used to purchase land and the buildings that go along with the land.</td>
</tr>
<tr>
<td>Credit provides financing</td>
<td>We, therefore, have credit which provides financing for non-real estate capital which can be: 1. operating capital - this is generally short-term credit, and 2. working capital - this is generally intermediate-term credit. There is also real estate credit which is generally used for buying a farm. Long-term credit is used for this.</td>
</tr>
</tbody>
</table>
WHAT A LENDER LOOKS FOR IN A BORROWER

Frame Reference: Script:

Title
Situation
Objective
Farm inspection
Livestock
Machinery
Buildings
Farm appraisal
Soil maps
Family visit
Records
Wife

What a Lender Looks for in a Borrower

Situation: Mr. B wishes to secure a loan to buy an additional 160 acres.

Objective: To evaluate the borrower and his farming operation.

Before a borrower is willing to make a loan, he is interested in seeing what type of farming operation the farmer has. Arrangements are made for a farm visit. (The lender has driven up, shaken hands with the farmer, and they have walked off.)

During the farm visit the livestock set-up should be evaluated. Problems and future potential should be discussed.

The farmer's machinery line should be analyzed to determine if it is adequate for the proposed farming situation.

Look over the buildings on the farm. Are they adequate for what the farmer is attempting to do?

Another important phase of the farm visit is to appraise the potential of the land that the farmer presently farms and that which he wishes to buy.

With the use of soil maps and the farmer's knowledge of the land, the appraisal can be made even during the winter months.

After the farm and the farming set-up has been visually observed, the lender sits down with the farmer and his wife to look over past records.

At this time, such records as Farm Record Association reports could be analyzed if they are available.

Net worth statements, income tax statements, and proposed budgets should be studied.

It is very important that the wife be included. Her interest and understanding in the farming operation will mean a lot to the lender.
Frame Reference: Decision

Script: From this will come the decision of whether a loan seems possible and what the repayment capacity could be.

Loan application

If everything seems in order, a loan application should be completed which will be further analyzed by the lending agency's personnel in charge of loans.

Further inquiry

Before granting a loan, the lender will want to inquire further about the prospective borrower at such places as the county court house for deeds and mortgages already incurred, the farmer's veterinarian, his banker, and his coop elevator.

If everything is in order and the loan application is approved, the farmer will receive the financing he needs to purchase the additional land.
Script:

What a Borrower Looks for in a Lender

It is very important to evaluate lender before securing a loan. Things that should be included are:

1. Character
   a. Does the lender have a reputation of fairness and honesty?

2. Lending policies
   a. What are the credit terms?
   b. What are the policies during hard times?

3. Permanence and dependability
   a. Can the lender expect help when he needs it most?

4. Experience and knowledge of farming
   a. Does the lender have up-to-date knowledge of farming?
   b. Does he have experience in making loans to farmers?

5. Cost of loan
   a. Figure in all possible costs.
   b. Calculate what the actual interest is.

With these items in mind, the lender can then search out the borrower who will provide him with the type of loan he wants.

The sources of loans vary with type of credit desired.
Frame Reference: Script:

Short-term

Short-term and intermediate-term loans can be secured from sources such as:
1. banks,
2. a local implement dealer,
3. the local elevator,
4. Farmer's Home Administration, and
5. Production Credit Association.

Long-term

Sources of long-term credit could also be:
Farmer's Home Administration and the local banker. But, generally life insurance companies and the Federal Land Bank handle most long-term loans today. Right now, due to the increasing interest rates, the Federal Land Bank seems to be the most available long-term credit source.