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A COMPARISON OF PROGRAMED AND LECTURE-DISCUSSION METHODS OF TEACHING FARM CREDIT TO HIGH SCHOOL YOUTH AND ADULTS.

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VOCATIONAL AGRICULTURE DEPARTMENTS CONSIDERED TO BE REPRESENTATIVE OF DEPARTMENTS HAVING ADULT PROGRAMS IN MARYLAND, DELAWARE, WEST VIRGINIA, PENNSYLVANIA, AND VIRGINIA WERE USED FOR THIS EXPERIMENT. PHASE ONE, IN 1961-62, WAS RANDOMLY ASSIGNED TO USE THE PROGRAMED OR THE LECTURE-DISCUSSION METHOD IN FARM CREDIT CLASSES. IN PHASE TWO (1962-63), BOTH METHODS WERE USED TO TEACH ALTERNATE CLASSES IN EIGHT SCHOOLS. A RANDOM SAMPLE WAS DRAWN FROM EACH SCHOOL FOR TEST COMPARISONS WITH EIGHT STUDENTS EACH FROM AGRICULTURE 9-10, AGRICULTURE 11-12, AND ADULT CLASSES. DATA WERE COLLECTED AND ANALYZED ON THE REMAINING STUDENTS IN EACH CLASSROOM. SOME CONCLUSIONS WERE -- (1) THE LECTURE-DISCUSSION METHOD OF TEACHING RESULTED IN SIGNIFICANTLY GREATER GAINS IN KNOWLEDGE IN PHASE ONE. SOME LECTURE-DISCUSSION TEACHERS USED TWICE AS MUCH CLASS TIME AS DID THE PROGRAMED-INSTRUCTION TEACHER, (2) WHEN THE AMOUNT OF TIME WAS CONTROLLED DURING PHASE TWO OF THE STUDY, THERE WAS NO SIGNIFICANT DIFFERENCE BETWEEN THE MEAN SCORES FOR EACH METHOD, (3) TEACHERS FELT THAT PROGRAMED INSTRUCTION SHOULD BE INTEGRATED WITH OTHER METHODS OF TEACHING, AND SOME BELIEVE THAT GOOD STUDENTS LEARNED MORE THAN FOUR STUDENTS FROM THIS METHOD. (FS)

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**The Pennsylvania State University
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University Park, Pennsylvania**

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**A Comparison of Programed
and Lecture-discussion Methods
of Teaching Farm Credit
to High School Youth and Adults**

by William L. Hull and David R. McClay

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INTRODUCTION

Programed instruction as a technological device for improving instruction has received recent attention in education. Teaching machines date from the 1920's, but the present emphasis on programing is a response to the current need for more learning to take place in less time. Experiments are being conducted to perfect various components of programing.

At present, many questions are unanswered and research continues on programed instruction as a method of teaching. A review of the literature revealed little programing research effort in vocational agriculture. It was decided to evaluate the effectiveness of programed instruction in vocational agriculture by conducting an experiment comparing it with the more conventional lecture-discussion method of teaching farm credit.

Farm life has been revolutionized by the addition of labor-saving mechanization. Technological innovations have increased pressures for larger farm units and more credit. The successful operation of a farm business demands efficient money management. High school and adult vocational agriculture students can learn how to evaluate capital needs per farm, construct a credit budget, determine the risk-bearing ability and repayment capacity of a farm, compute interest charges, and design a repayment plan which will be practical and effective. A thorough knowledge of farm credit may help to increase the profit from the farm business and result in a higher standard of living for the farm family.

The purpose of this experiment was to compare the effectiveness of programed instruction with the lecture-discussion method of teaching farm credit to vocational agriculture students on three grade levels. Students were retested 2 months after the experiment was conducted to evaluate retention of information presented through each method of teaching farm credit.

DEFINITION OF TERMS

As used in this investigation, farm credit means obtaining, using, and repaying money necessary in farm procurement, production, and marketing.

Programed instruction is a self-instruction procedure in which a student responds to written constructed sequences of educational materials.

Lecture-discussion is the traditional instructional procedure utilized in vocational agriculture. Primarily verbal, it consists of a problem-solving approach to instruction which relies heavily on the interests and needs of the students. Most vocational agriculture instructors utilize resource materials and discussion in their presentations.

A PROGRAMING PROSPECTUS

Programed instruction has been compared (2) to the Socratic method of teaching, question by question. About 95 per cent of the programs now in use are of the Skinnerian type (6). These linear programs lead a student along an orderly systematic sequence in a step-by-step manner. Each step is called a frame. It usually consists of a rule or principle explained and supplemented with examples. At the end of the frame the student makes one or more responses. These may be either overt or covert. According to Stolurow (9), students do as well or better when they are required to read the program without making any overt responses.

Skinner (7) contends that reward and reinforcement are more skillfully and economically used in programs than in most traditional classroom instruction. With either the covert or overt response, the student is rewarded for the right answer.

One of the advantages claimed for programed instruction is individualized instruction. Students work at their own pace. Those with the correct answers may proceed without rereading the material. Certain efficiencies in student and teacher time are pointed out by the advocates of programing. The teacher, freed of teaching details, may help the student with creative questions which go beyond the regular classroom assignment. Slow students may also receive special attention.

Markle (4) has suggested that programing is a new kind of communication between teacher and student. Essentially the student is dealing with a printed tutor. Instruction flows to the student from the page and then, when the student is asked to respond to a question, from the student to the page. Cronbach (1) states that the trial and feedback step seems most important (i) with learners who have to be kept at the task by artificial controls or (ii) with subject matter that cannot easily be put into words or (iii) with instructional materials that are unclear.

Programed instruction attempts to highlight important aspects of the content material. With linear programs, a kind of internal logic may be built into the sequences of frames. Researchers do not agree on the importance of sequence in programing. It is likely that the importance of sequence depends on several variables, including the age and abilities of the student, the kind of tasks, and logic of the instructional material.

One of the more promising aspects of programed instruction involves its use in research. It focuses attention on the process of teaching. There seems to be little doubt that new insights into learning theory will be gained. Programed procedures (5) offer more experimental control by (i)

eliminating the direct presence of the teacher as an instructional variable and (ii) standardizing the presentation of instruction.

Student attitudes vary considerably toward programed instruction. In general, little relationship exists between student attitudes and what is learned. Student response to programed instruction has been reviewed by Lumsdaine (3). Student interest begins to lag when programed material takes long periods of time.

Some psychologists (8) contend that a successful program must have the "consent of the learner." A student must understand why he should place himself under the control of a program. With more humor and human interest, programs may be more acceptable in the future.

The record of programed instruction has been a creditable one. Schramm (6) summarizes the current outlook, "Programs have been used successfully at all levels of the educational system, all levels of ability from the slow learners to the very best students, and to teach a great variety of academic subject matter and verbal and manual skills. We can accept confidently, therefore, the conclusion that programs do teach. But how do they teach, and what combinations of characteristics make them teach better, are still much in doubt."

METHODS AND PROCEDURES

GENERAL PLAN OF THE EXPERIMENT

In the fall of 1961, 20 schools were selected to participate in Phase One of the study. Only schools having vocational agriculture departments with minimum enrollments of at least eight students in Grades 9 and 10, 11 and 12, and the adult class were considered. Twenty schools were randomly assigned to either the programmed or the lecture-discussion method and all classes in a particular school were taught farm credit by the method assigned.

Phase Two of the study was conducted during the 1962-63 school year. In this phase, the teachers used both the programmed and lecture-discussion methods of instruction to teach alternate classes of students. Students in a particular class received only one method of teaching. The methods were not mixed in any class. The teachers were randomly assigned to a particular method so that an equal number of students in Grades 9 and 10 were tested with an equal number of students in Grades 11 and 12. This made the numbers of students in the two methods of teaching equal.

DEVELOPMENT OF THE INSTRUMENTS AND TESTS

Information regarding farm credit was prepared and printed in three booklets: (i) lesson plans for teacher use, (ii) a resource booklet, for student use, containing factual information about farm credit, and (iii) a programmed booklet, for students, containing the same information as the above two items. The lesson plans were used by the teachers who employed the lecture-discussion method of teaching. Only the students in the lecture-discussion method group received the information booklet. Each student taught by programmed instruction was given a copy of the programmed booklet. This unit was written in a logical sequence following the Skinner technique of small, sequenced steps necessitating overt, constructed responses by the student.

A criterion test was developed and used (i) as a pretest before the unit was taught, (ii) as a test after the unit was taught, and (iii) as a retest, 2 months later. The same test was used each time, only the sequence of the questions was changed. This procedure was used for both years of the experiment. The test, administered immediately upon completion of the unit, served as the primary criterion measure because most of the control

over the environment and the individual was exerted at that time. However, the retest 2 months later was a useful measure of the amount of knowledge retained by the students. It was the criterion measure for the answer sheet variable.

The criterion test was partitioned into five areas (i) acceptance of personal responsibility, (ii) source of credit, (iii) cost of credit, (iv) negotiation of the loan, and (v) evaluation. The questions were pretested prior to use in the experiment. Questions which were shown to be poorly constructed or which failed to discriminate were eliminated. The final form of the test consisted of 60 questions.

Two types of answer sheets were used when the test was given—a simple "black-out" type and an "erasure-type" feedback answer sheet. The latter answer sheet permitted the student to know immediately if his answer was correct. According to Skinnerian thinking, an immediate knowledge of the correct answer reinforces the response and learning becomes more permanent. The factor of immediate reinforcement was tested 2 months later with the retest.

Control measures were used as covariates in the experiment. The *Reading Comprehension Test, Form 2A* of the *Cooperative English Test* served as a control on individual differences in aptitude as measured by reading. This test was used only in Phase One of the experiment. A Farm Credit Involvement Index was developed and used as a control during Phase Two of the study. It consisted of a checklist of activities related to farm credit which could have been participated in by the students. The pretest, administered before the unit was taught, also acted as a covariate or control variable during both phases of the experiment.

An evaluation form was developed and sent to the teachers asking for their opinions of instruction used in the study.

SELECTION OF THE SAMPLE

Two samples of schools—twenty for Phase One and eight for Phase Two—were selected. The vocational agriculture departments in these schools were considered to be representative of all vocational agriculture departments having adult programs in their respective states. The schools used in 1961-1962 were:

Frederick High School, Frederick, Md.
North Carroll High School, Greenmount, Md.
Newark High School, Newark, Del.

Milford High School, Milford, Del.
Berkeley Springs High School, Berkeley Springs, W. Va.
Hedgesville High School, Hedgesville, W. Va.
Clark County High School, Berryville, Va.
James Wood High School, Winchester, Va.
Dayton Joint High School, Dayton, Pa.
Dover Area High School, Dover, Pa.
Eastern Lancaster County Joint High School, New Holland, Pa.
Hollidaysburg Community Joint High School, Hollidaysburg, Pa.
Juniata Joint High School, Mifflintown, Pa.
Marion Center Joint High School, Marion Center, Pa.
Middleburg Area Joint High School, Middleburg, Pa.
Oxford Area Joint High School, Oxford, Pa.
Punxsutawney Area Joint High School, Punxsutawney, Pa.
Penns Valley Area Joint High School, Spring Mills, Pa.
Shippensburg Area Joint High School, Biglerville, Pa.
Upper Adams Joint High School, Biglerville, Pa.

The schools in Phase Two (1962-1963) were:

Cameron High School, Cameron, W. Va.
Hereford High School, Parkton, Md.
Middletown High School, Middletown, Del.
Strasburg High School, Strasburg, Va.
Blue Mountain Joint High School, Cressona, Pa.
Chambersburg Area Joint High School, Chambersburg, Pa.
Danville Area Joint High School, Danville, Pa.
Gettysburg Joint High School, Gettysburg, Pa.

In Phase One, the schools were randomly assigned to either the programmed or lecture-discussion method of teaching. A random sample of 24 students was drawn from each school, 8 from each of the three grade level categories: Agriculture 9 and 10, Agriculture 11 and 12, and adults. Half of these students used one kind of answer sheet and half used the other.

The design for Phase Two of the experiment was similar. Eight schools, four from Pennsylvania and four from other states, were selected. None of the schools used in Phase One were used in Phase Two. A random sample of eight students was drawn from each of the combined classes. Half of the sample received one kind of answer sheet and half the other.

During both phases of the study, data were collected on the remaining students in each classroom.

CONDUCTING THE EXPERIMENT

Phase One of the study began in the fall of 1961. The experimenter, a graduate assistant in the Department of Agricultural Education, visited each school prior to the experiment. He delivered the instruments and instructed the teachers in the procedures of the study. This was repeated in the second phase of the experiment. The vocational agriculture teacher in the cooperating schools taught the unit and administered the tests. This prevented introducing the bias of a strange teacher. All students in each high school vocational agriculture class participated in the instruction.

The answer sheets were scored by the experimenter and the results returned to the cooperating teachers. The results were punched on IBM cards and processed at The Pennsylvania State University. Analysis of covariance was used to test significance of differences in the sample groups of equal numbers of students. The test scores of all the students in the schools were used to compute some of the tests of significance.

During Phase One, the teachers were asked to spend from 5 to 12 hours of class time teaching the unit in both the lecture-discussion and the programed instruction methods of teaching. In Phase Two, the time for both methods of instruction was 6 hours.

PRESENTATION AND DISCUSSION OF THE EXPERIMENTAL RESULTS

ANALYSIS OF THE MAJOR VARIABLES

The major independent variables in this study were methods of teaching farm credit (programed and lecture-discussion); grade levels (Agriculture 9 and 10, 11 and 12, and young and adult farmers); and type of answer sheet (black-out type and the erasure-type feedback). A portion of the variation in the second phase of the study was assigned to differences among schools. School as a variable was intended only to act as some control on situational differences. No systematic investigation of the reasons for the variation was made.

The criterion measure used to analyze the variables was a paper and pencil test and retest made up of two kinds of questions, the situational-type and the factual-type. The situational-type questions contributed more to learning than the factual-type. Of the first 42 questions requiring specific facts, 54.5 per cent contributed to learning. In the last 18 questions, preceded by problem situations which required application of reasoning, 72 per cent contributed to learning. "Contributed to learning" is defined as a significant increase from pretest to test in the proportion of high school students that chose the correct answer. During Phase One of the experiment, situational questions were more effective than factual questions in reflecting the effect of the method of teaching.

TEACHING METHODS

The effectiveness of programed instruction when compared with lecture-discussion as a method of teaching farm credit was measured by a test on knowledge of farm credit. This variable was tested in both phases of the study with similar, but not identical, results.

During Phase One, the mean score for all grade levels taught by the lecture-discussion method was 38.5. This was significantly higher at the .01 level than 35.0, the comparable score for programed instruction. Both of the above scores were taken at the time of the test; the retest scores for both methods were not significantly different. As Table 1 illustrates, the mean score for the grade levels increased directly and somewhat proportionally for both methods of teaching with grade level of maturity. Scores of students in the 9th and 10th grades indicated less retention of information by this group than by the older students. They were the only

TABLE 1. Mean scores for knowledge of farm credit by two teaching methods and three grade levels, Phase One, (1961-1962)

Grade Level	N	Reading Ability	Mean Scores		
			Pretest	Test	Retest
PROGRAMED INSTRUCTION					
Agriculture 9 & 10	80	144.6	26.6	30.9	31.2
Agriculture 11 & 12	80	145.3	28.8	33.9	34.2
Adults	80	150.8	33.7	40.1	42.6
LECTURE-DISCUSSION					
Agriculture 9 & 10	80	145.3	25.3	33.9	33.2
Agriculture 11 & 12	80	146.3	30.1	37.6	38.6
Adults	80	148.6	35.4	43.9	44.9

groups to decrease on the retest during the first phase of the study.

The mean group scores for high school students in both methods of teaching during Phase Two of the study decreased significantly from the test to the retest. The adult scores during both years increased from test to retest. The Phase Two design incorporated school, in place of grade levels, as a variable. Table 2 reports the mean scores of high school students by methods and schools. When both methods of instruction were combined, the school variable was significant at the .01 level at the time of the retest, but not at the time of the test.

Data from Phase One contained equal numbers of students from each class in each school in both methods. This was also true for Phase Two except that no adults were included in the random sample. Table 2 illustrates the continued trend of higher scores in the lecture-discussion method during Phase Two. When the effect of method was tested by analysis of covariance, the difference was not significant.

Table 3 lists the adult farmer scores by the programed instruction and the lecture-discussion methods of teaching farm credit in Phase Two of the experiment.

TABLE 2. Mean scores for knowledge of farm credit by two teaching methods and eight schools, Phase Two (1962-1963)

School	N	Involvement Index	Mean Scores		
			Pretest	Test	Retest
PROGRAMED INSTRUCTION					
1 ^a	4	5.9	24.8	28.1	28.4
2 ^a	4	3.8	26.6	28.6	31.1
3 ^b	4	4.0	34.8	35.5	32.1
4 ^a	4	5.1	25.9	27.0	26.6
5 ^b	4	5.8	32.1	34.4	34.4
6 ^b	4	6.3	28.8	29.5	23.0
7 ^b	4	3.8	30.4	34.4	26.1
8 ^a	4	5.4	27.3	25.4	22.9
LECTURE-DISCUSSION					
1 ^b	4	3.9	22.4	29.3	26.3
2 ^b	4	4.1	31.8	35.4	33.6
3 ^a	4	3.1	25.0	30.1	34.6
4 ^b	4	5.0	24.4	25.8	29.3
5 ^a	4	3.6	27.8	31.3	29.0
6 ^a	4	2.6	26.5	32.4	25.6
7 ^a	4	2.1	22.1	29.3	26.6
8 ^b	4	6.6	23.9	34.6	26.8

^a11th- and 12th-grade classes

^b9th- and 10th-grade classes

TABLE 3. Mean scores for knowledge of farm credit by two teaching methods with adults only, Phase Two (1962-1963)

Method	N	Involvement Index	Mean Scores		
			Pretest	Test	Retest
Programed Instruction	30	6.8	36.6	43.2	42.7
Lecture-discussion	14	6.7	39.3	42.0	44.7

TABLE 4. Mean scores for knowledge of farm credit by three grade levels, Phase One (1961-1962)

Class	N	Reading Ability	Mean Scores		
			Pretest	Test**	Retest**
9 & 10	160	145.0	26.0	32.4	32.2
11 & 12	160	149.8	29.4	35.7	36.4
Adult	160	149.7	34.6	42.0	43.8

**Significant at the .01 level by analysis of covariance

GRADE LEVELS

The second independent variable tested in the study was the effect of three grade levels on knowledge of farm credit. The mean reading comprehension scores for the age group in Table 4 increased with the increased chronological age of the group. The coefficient of correlation between the reading comprehension score and the test score was .38, which was significant at the .01 level.

Phase One of the study incorporated grade level in the factorial design of the study. Table 4 gives the mean scores for knowledge of farm credit in three grade levels. The mean scores for grade levels were significantly different both at the time of the test and retest. Table 5 shows data from Phase Two of the study. A single classification analysis of covariance test of significance was run on all students in the experiment. This table also shows the test and retest scores to be significantly different for the three grade levels. A significant gain in knowledge occurred in each grade level during both years of the experiment.

An element of maturity must be involved in learning farm credit. Apparently the subject of farm credit requires an ability to understand and comprehend the various factors of money management. This also implies some familiarity with financial transactions. It is evident that the adults were able to check more items on the Farm Credit Involvement Index than students in either the 9th and 10th or the 11th and 12th grades.

TABLE 5. Mean scores for knowledge of farm credit by three grade levels, Phase Two (1962-1963)

Class	N	Involvement Index	Mean Scores		
			Pretest	Test**	Retest**
9 & 10	229	3.9	25.8	29.3	28.1
11 & 12	147	5.2	28.0	32.8	29.8
Adult	44	6.8	37.4	42.8	43.3

**Significant at the .01 level by analysis of covariance

ANSWER SHEETS

Another independent variable in the experiment was the type of answer sheet used by the subjects. Since the black-out type answer sheet and the erasure-type feedback answer sheet were given to the students at the time of the test, the effect of this variable did not become operative until the time of the retest two months later. The test scores replaced the pretest scores as the control variable in the statistical analysis. More control of individual differences could be obtained in this manner.

TABLE 6. Mean scores for knowledge of farm credit by two multiple-choice answer sheets, Phase One (1961-1962)

Answer Sheet	N	Reading Ability	Mean Scores		
			Pretest	Test	Retest
Black-out type	240	145.28	29.31	35.74	34.95
Erasure-type	240	148.35	30.67	37.66	39.93
Difference				1.92	4.98**

**Significant at the .01 level by analysis of covariance

TABLE 7. Mean scores for knowledge of farm credit by two multiple-choice answer sheets, Phase Two (1962-1963)

Answer Sheet	N	Involvement Index	Mean Scores		
			Pretest	Test	Retest
Black-out type	64	4.39	26.34	29.72	27.44
Erasure-type	64	4.48	27.94	31.64	29.61
Difference				1.92	2.17

As Table 6 shows, the mean retest score for the erasure-type answer sheet in Phase One was significantly higher than the black-out type answer sheet. Although the trend was in the same direction during Phase Two of the study, Table 7 shows that the difference due to the answer sheet was not significant. When the scores of students with the erasure-type feedback answer sheets were compared with scores of all other high school students in Phase Two of the study, the difference was not significant. The covariates of involvement index and the test score were positively related to the retest scores.

CONTROL OF THE ENVIRONMENT

One of the problems in conducting an experiment in the social sciences is the control of situational and environmental variables. The geographic distribution of the vocational agriculture departments in this study covered one-third of Pennsylvania and parts of four other states. The different local conditions may have increased the experimental error in the study.

The amount of control on the local situation was limited. The teachers in Phase One of the study spent more time on the farm credit unit than was suggested. Some teachers using the lecture-discussion method of teaching averaged 12 hours of instruction per student while students on programed instruction spent only 5 hours. This variation in time may have influenced the results of this phase of the experiment. Therefore, during Phase Two, the time was controlled at 6 hours of instruction for both the programed and the lecture-discussion groups. The remaining classroom environment was unchanged. The teachers administered the tests and conducted the experiment on the local level. Only the local teacher was in contact with the students.

TABLE 8. Mean scores for knowledge of farm credit by high school students in eight school districts, Phase Two (1962-1963)

School Number	N	Involvement Index	Mean Scores		
			Pretest	Test	Retest**
1	16	4.88	23.56	28.69	27.31
2	16	3.94	29.19	32.00	32.38
3	16	3.56	29.88	32.81	33.38
4	16	5.06	25.13	26.38	27.94
5	16	4.69	29.94	32.81	31.69
6	16	4.44	27.63	30.94	24.31
7	16	2.94	26.25	31.81	26.38
8	16	6.00	25.56	30.00	24.81

**Significant at the .01 level by analysis of covariance

Phase Two of the study was designed to measure the amount of variation due to schools at the time of the test and retest. Table 8 shows the mean scores for the eight schools, based on a balanced random sample of high school students from each school in Phase Two of the experiment. No significant differences among the schools were evident at the time of the test. However, significant differences among the schools were present at the time of the retest. No effort was made to control the kinds of student activities between the time of the test and retest. These differences at the time of the retest may reflect the diversity of activity during this two-month period.

CONTROL OF INDIVIDUAL DIFFERENCES

Traditionally, students in vocational agriculture have varied both in interests and abilities. Such a heterogeneous group offers a challenge to any controlled experiment. During Phase One, all students in each vocational agriculture department were given a test of reading ability. The raw test scores of the 889 students were converted to a percentile rating based on national norms. The observed proportions of students in percentile intervals are presented in Table 9. Since the national norms are expressed in percentile intervals, the expected proportion in each interval would be 20 per cent of the students. Table 9 shows that the observed proportion of students in

TABLE 9. *A comparison of the distribution of reading ability scores of 889 vocational agriculture students with national norms, Phase One (1961-1962)*

National Norm Percentile Intervals	Observed Proportion of Students		
	Grade 9-10** n = 403	Grade 11-12** n = 308	Adults** n = 178
81-100	.06	.07	.10
61-80	.19	.14	.19
41-60	.32	.20	.27
21-40	.37	.30	.29
0-20	.06	.30	.15

**The difference in observed and expected frequencies was significant at the .01 level by Chi square test for each of the three grade levels

each of the two upper intervals beginning at the 61 percentile point was less than the expected proportion. Three-fifths of the 11th- and 12th-grade vocational agriculture students were in the lower two-fifths of the normal distribution for the reading ability test.

The programed and resource booklets were written for readers for all age and ability levels. The reading comprehension test was given to determine individual differences in aptitude as measured by reading. The correlation coefficient of .38 between the reading comprehension test scores and the criterion test score was significant at the .01 level. Reading comprehension was an effective covariable during Phase One of the experiment.

The below-average reading comprehension scores for vocational agriculture students indicate that they may have difficulty understanding programed instruction materials. Programed materials need to be written and evaluated so as to be within the comprehension of the students. Consequently, the vocational agriculture students who used the programed materials may have been at some disadvantage when compared with the students taught by the lecture-discussion method. This problem was corrected by the use of the reading comprehension test score as a covariate.

The pretest was used as a co-variable for the individual's prior knowledge of farm credit during both phases of the experiment. The regression of the test on the pretest was significant at the .01 level during both phases. This indicated that the pretest significantly predicted which students would score high on the criterion measure. In this way, the criterion scores

of the individual students were adjusted for prior knowledge of the subject.

A third attempt to control individual differences was undertaken during Phase Two of the experiment. An involvement index was developed to measure the familiarity of students with farm credit based on a frequency count of activities. Students were asked to check the activities in which they had been engaged. These activities made up the Farm Credit Involvement Index. The activities were designed for 9th-grade students through adult farmers. The regression of the test score on the involvement index was not significant when determined for the sub-sample of 128 high school students. For the total of 420 high school and adult students the regression was significant at the .01 level. It was shown in Table 5 that the adults checked more activities. The nonsignificance of the involvement index with a small group of high school students indicated that it is not refined sufficiently to measure small variations in a relatively homogeneous group.

The pretest and the involvement index did not correlate significantly. In contrast, the reading comprehension scores and the pretest scores during Phase One of the experiment were significantly correlated. Also, the reading comprehension score and the pretest were effective in controlling individual differences. The involvement index was not as effective as the other two covariates in controlling individual differences.

Farm Credit Involvement Index

(Please check the blanks which apply).

- ___ 1. Did you take an annual inventory of the net worth of your farm last year?
- ___ 2. Did you have to produce a financial statement any time last year?
- ___ 3. Did you pay off a small short-term loan (for the purchase of fertilizer or seed, etc.) since January 1, 1962?
- ___ 4. Did you pay off an intermediate-term loan (for the purchase of livestock or machinery, etc.) since January 1, 1962?
- ___ 5. Did you renew a small short-term loan since January 1, 1962?
- ___ 6. Did you renew an intermediate-term loan last year?
- ___ 7. Did you renew a long-term loan, such as a mortgage, last year?
- ___ 8. Did you borrow any money for a short time (1 to 12 months)?
- ___ 9. Last year, did you negotiate a loan for more than 12 months?
- ___ 10. Have you opened new charge accounts since January 1, 1962?
- ___ 11. Do you have a credit card?
- ___ 12. Did you purchase consumer goods (household appliances, furniture, etc.) on time last year?
- ___ 13. Did you lease any farm land last year?
- ___ 14. Have you ever signed a profit-sharing agreement on a livestock or crop enterprise?
- ___ 15. Do you have a savings or checking account?
- ___ 16. Do you own stocks or bonds in a company?
- ___ 17. Do you have a life insurance policy?
- ___ 18. During this last year, have you loaned money to anyone?
- ___ 19. Have you ever been a member of any organization which cooperatively financed a project? (Example: An FFA chapter chain gilt)
- ___ 20. Have you ever been elected treasurer or handled the finances of a civic club, church, FFA, or other organization?

TEACHER EVALUATION

Since the eight teachers in Phase Two of the study had an opportunity to use both methods of teaching, they were asked to express their opinions about the programmed and the lecture-discussion methods of teaching farm credit to vocational agriculture students. They filled out a two-page questionnaire, part of which is reproduced in Table 10. They were asked to respond to five statements indicating their opinions about programmed instruction. All of the teachers agreed that programmed instruction should be integrated with other methods of teaching. Teachers in Phase One of the study noticed a lack of interest among the younger students. According to the experimenter during the first year, the subject matter alone lacked the necessary interest generated by involvement to motivate the younger students. The eight teachers in Phase Two agreed that although the programmed instruction students appeared interested, they had fewer questions than the students in the lecture-discussion groups.

TABLE 10. Number of teachers indicating agreement or disagreement with statements about programed instruction, Phase Two (1962-1963)

	Strongly agree	Agree	Uncer- tain	Dis- agree	Strongly disagree
1. Classroom discussion is more effective than programed instruction as a method of teaching farm credit	0	6	1	1	0
2. Programed instruction makes students think	0	8	0	0	0
3. Good students seem to get more out of programed instruction than poor students	5	3	0	0	0
4. Classroom discussion permits a more detailed explanation of the subject than programed instruction	3	5	0	0	0
5. The rate of learning in programed instruction is geared to the ability of the student, so that the slow learner learns the same amount as the fast learner	0	1	2	4	1

SUMMARY AND CONCLUSIONS

The purpose of the study was to evaluate the effectiveness of two methods of teaching farm credit to vocational agriculture students and to investigate the effect of class level and type of answer sheet on the criterion measure. Although the two phases of the study dealt with different sample groups of students, the experiment used the same instruments and students in the same geographic area. The geographic distribution and time sequence give the study some breadth and power in the generalization of conclusions to specific situations.

General statements that may be made from the results of the two phases of the study are:

1. A gain in knowledge was made by students in both methods of teaching farm credit. The lecture-discussion method of teaching the unit resulted in significantly greater gain in knowledge in Phase One. During the second phase of the experiment, the gain in knowledge from lecture-discussion was not significantly different from the programmed instruction method of teaching. The results during Phase One of the experiment may have been influenced by the time variable. Some teachers using the lecture-discussion method of instruction used twice as much class time as the average of the teachers using the programmed instruction.

2. A significant gain in knowledge occurred at all three grade levels during both years of the experiment. Adults started with the most knowledge and made the highest scores at both testing times.

3. The erasure-type feedback answer sheet produced a significant gain in knowledge during Phase One, but showed no significant difference in Phase Two.

4. At the time of the test, the eight schools participating in Phase Two of the experiment were not significantly different. However, there were significant differences among schools two months later when the students were retested. This may have been influenced by the instruction and involvement the students experienced in the two-month period.

5. In general, high school students in this study do not read as well as students on whom national norms were developed.

6. The involvement index was effective as a control variable on the total group of observations during the second phase; it did not adjust the scores significantly in the smaller sample of high school students only.

7. The evaluation submitted by teachers participating in the second year of the experiment indicated that programmed instruction should be

integrated with other methods of instruction. Students appeared to find programmed instruction interesting. Some teachers believed that good students learned more than poor students from this method of instruction.

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DIGEST

This experiment was conducted to compare the effectiveness of programmed instruction with the lecture-discussion method of teaching farm credit to three grade levels of high school vocational agriculture students. The multivariate design involved 480 students from 20 schools in 1961-1962, and 128 students in 8 schools in 1962-1963. Schools in five states participated. In Phase One (1961-1962), eight students from grade levels Agriculture 9 and 10, Agriculture 11 and 12, and young and adult farmer classes in each school were selected at random. In Phase Two (1962-1963), insufficient enrollments in the schools selected precluded the use of the third category. Scores made by adults and students not selected for the Phase Two multivariate design were included in single classification tables.

The major variables were teaching method, grade level, and answer sheet. Individual differences among students in 1961-62 were controlled by a standardized test on reading ability and by a pretest on knowledge of farm credit. The following year, an involvement index was substituted for the test of reading ability. The criterion measures were a test and retest specially prepared and validated for use in this experiment. Four students in each grade level during both years of the experiment used an erasure-type feedback answer sheet at the time of the test. Other students used the conventional black-out type of multiple-choice answer sheet.

The lecture-discussion method of teaching farm credit was found to be significantly better than programmed instruction in Phase One of the experiment. Some lecture-discussion students used twice as much time as did the programmed-instruction students. When the amount of time was controlled during Phase Two of the study, there was no significant difference between the mean scores for each method, although the higher scores for lecture-discussion continued.

Generally speaking, as the age of the students increased, the pretest, test, and retest scores also increased. The same trend was evident in the reading comprehension scores and the involvement index scores. Students in each grade level increased their knowledge of farm credit from the pretest to the test. The variability due to grade level was significant in both years of the experiment. Although the answer sheet variable was found to be statistically significant in Phase One, it was not so in Phase Two.

In Phase Two, the teachers returned a questionnaire inviting their opinions about programmed instruction. They felt that it should be integrated with other methods of teaching; that while stimulating thinking it results in fewer questions being asked than in the lecture-discussion method; and that good students tend to derive more benefit from it than do those of lesser ability.

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