EVALUATION OF A CURRICULUM MODEL
FOR THE BIOLOGICAL SCIENCES

by

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Chapter 1

INTRODUCTION

A new approach to teaching biological sciences is needed, one which is applicable in all areas of the discipline. This study was an attempt to verify the success of a practical, research-oriented curriculum model. The model was implemented in the Department of Agronomy, Virginia Polytechnic Institute and State University in the Fall Quarter of 1972. Observations from a previous program at another institution which employed a similar model indicated the potential of this model. This pilot program, which used the techniques described in the model, was developed and initiated at this school over a 5-year period. Courses using the model to supplement lectures, but not replace them, were taught as Plant Ecology and Plant Physiology. Student acceptance of the new program appeared good and attitudes toward it appeared favorable. Course enrollments increased, compared to standard courses which declined in enrollment or were dropped altogether. Students used research methods and equipment not used prior to the new program's inception. Student papers were submitted and occasionally accepted for publication. Student requests for additional library material in the subject areas were made. Professional activities, such as student-run field days and seminars, were initiated. None of these activities were carried out prior to establishment of the new curriculum and were taken as indications of improved student attitudes. However, no actual tests were administered to determine student attitudes, nor were quantitative tests run to determine the effect of the model on student achievement.

To determine the validity of previous impressions and observations and to observe the results under different circumstances, the program was implemented and tested under more controlled conditions. Effects on attitude, grades, and course attendance were analyzed and conclusions were obtained using a beginning class in agricultural science.

The specific problem was to determine the effects a curriculum model for the biological sciences would have on improving attendance, attitudes and student achievement levels when compared to students who had not been exposed to the model.

DELIMITATIONS

It was believed that with modifications such a curriculum model could apply to almost any discipline. However, this study and results apply only to students in an introductory agronomy course.

OVERVIEW

This dissertation is organized into four chapters. Chapter One contains an Introduction, Delimitations, an Overview, a Thesis, a Literature Review, a Statement of the Problem, Definitions and Hypotheses.

Chapter Two is entitled "Methodology." This chapter deals with the selection and assignment of students to treatment or control groups. Description and application of treatments are included. In the section discussing measurement of variables, a description of the attitude instrument, its development, scoring, administration, validity, reliability and factor analysis is given. A discussion of internal and external validity of the study concludes the chapter.

The third chapter deals with results. Hypotheses are restated and results are reported by hypothesis.

A discussion of the results, their implications, and the conclusions which can be drawn from the study are in Chapter Four. A summary of the project concludes the paper.

LITERATURE REVIEW

Historically, school curriculums have at least reflected the needs of society. As societies have changed, curriculums have changed to meet changing needs (7). However, these changes in curricula have often lagged far behind society's need for such changes. With today's knowledge explosion, coupled with the tight job market, higher education must become more specialized and relevant to help students find jobs in our changing technological society. Far too often, curriculua found in both technical and liberal arts institutions are not meeting these needs.

Flocker (10) points out that most educators cling to traditional methods of instruction and curriculum content. He advocates new teaching approaches which will involve the students in course activities. This involvement is a form of motivation which can stimulate interest in the subject matter. Both Scholtes (28) and Bertrand (4) believe that lack of motivation means lack of learning. How can such motivation be achieved? Bertrand (4) questions traditional methods and activities and indicates that changes are needed in curriculum and methodology to better prepare students to meet changing industrial demands. Smith (29) notes that even on the graduate level students are rarely given instruction in such important job-related areas as scientific writing.

A study at Iowa State indicated that relevancy of material, practical applications and interest in the subject were some of the most important factors that contributed to student motivation (28). Other surveys of graduate and undergraduate students produced similar answers (26). They felt that a student could be motivated by course content, an individual professor, or particular methodology. Other factors, such as exposure to current research, contact with industry, involvement with laboratory research and small discussion groups, as well as the inclusion of material which would help achieve professional goals and develop professional attitudes, were also listed as important aspects of motivation (24, 28). It should be noted that all factors mentioned related course material to requirements of the job market.

Educators, beginning to become aware of the challenges existing in higher education today, are starting to meet the problems in many ways. These changes are occurring in organization, curriculum content, and teaching methods to improve what Bertrand (4) calls the intellectual, sociological and physical environments necessary to learning. The changes include course reorganization, such as the core curriculum developed at Western Illinois (11), and summer institutes in applied soil and plant sciences recently proposed at Virginia Tech (24). The integration of biology, chemistry, and environmental sciences into agronomy and other agricultural curriculums are examples of content changes. Interdisciplinary programs, such as that found at the University of Wisconsin, which combine soil science with land use planning, is another example of curriculum change (3).

Perhaps the most evident change is in teaching methodology which frequently produces corresponding curriculum changes. In general, teaching innovations are designed to stimulate student involvement and motivation in course activities (10). Laboratories, once of a very explicit nature, are becoming more research oriented on both the graduate and undergraduate levels, as Hall (16) recently noted. Other innovations include video-audio self-tutorial systems (10); the use of tapes of research and professional activities, field days, and lectures by outstanding scholars (5); and special events throughout the course (4). New equipment, such as the photoplanimeter used at Virginia Tech (36, 37) and the photosynthetic chamber used in demonstrations at Wisconsin by Moss (22), are being introduced to students to develop interest as well as to improve their training. New laboratories, often located off-campus, and perhaps shared by university and industrial or governmental research groups, such as the Savannah River Laboratory, Aiken, South Carolina (17), are now being made available for student use.

These developments are attempts to answer students' requests for relevant material, applied courses, contact with research and industrial leaders, and individualized programs and instruction (26, 28, 29). Administrators like Scholtes (28), Bertrand (4), and Mitchell (21), as well as Reetz (26) and others (28, 30) make the point that relevancy and involvement are two key factors in student motivation and learning.

THESIS

The thesis underlying the study was that students who are motivated will have higher achievement, will attend class more regularly, and will have a more favorable attitude toward courses and the agricultural profession than previously. Motivation appears to be essential to successful students. This seems to be true whether motivation is intrinsic or extrinsic, whether it comes from interest in majors and courses, from desire for occupational or material rewards, or from other reasons. Poor attitudes toward school as well as low academic achievement can undoubtedly

Figure 1. Relation of Independent to Dependent Variables in the Treatment Group

Causal Variable	Intervening	Dependent End-Result Variables
1. Introduction: Experimental Design, Scientific Papers, Research Applications.		Attitude Toward Profession
2. Instrumentation for Agricultural Research.		
3. Greenhouse Orientation and Greenhouse Research, Staff.		
4. Practical Application of Experimental Design. Student Research.	Motivation	Grades
5. Small Plot and Field Research Techniques. Turf Center Director.		
6. Data Collection and Interpretation. Research Results Presented in Scientific Paper Form.		
7. Sampling in Research - Soil Sampling. Soil Interpretation.		
8. Evaluation and Projection of Project.		Attendance

be traced, in part, to low motivation.

It was believed that motivation of students in agricultural sciences could be increased by exposing them to several activities not found in a typical undergraduate course. First, students would be exposed to the methodology and applications of research in a manner seldom experienced by undergraduates. Second, students would have contact with individuals and research centers which were nationally known in their respective fields. Third, students would have an opportunity to conduct original research. Fourth, students would be able to observe practical application of their own, as well as others', research. Fifth, students would become involved in practical and professional activities, such as soil sampling and seminar participation. Finally, the students in the test group would be exposed to information regarding ecology, pathology, and physiology, directly and indirectly related to the course.

If students had the above experiences, it was believed that this additional exposure and individual involvement would cause the student to view his profession in broader and more favorable terms than those students not exposed to the treatments. If a student could see relevance in his studies and courses, it was believed that his motivation would be increased. Further, it was felt that such motivation would be reflected in improved attitudes, grades and attendance, compared to a similar group which had not had such experiences (Figure 1).

DEFINITIONS

Curriculum Model for the Biological Sciences

A. Part I of the model included a modified lecture-individualized instruction program. A three-hour, non laboratory section was taught by one instructor. This consisted of three, one-hour sessions per week for ten weeks. Three-fourths of the meeting periods were devoted to lecture, while the remaining one-fourth was devoted to individualized student work. A course outline for part one of the model is included in Appendix II.

B. Part II of the model was taught by a second instructor. Students were exposed to certain experiences for a total of eight, one-hour sessions over a ten-week period and were considered treatments. These treatments were grouped into the following categories:

1. In-class instruction by second course instructor;
2. Student involvement and participation activities;
3. Activities directed by other department members. These activities related to either student/faculty research, practical application of principles and concepts, or professional growth activities.

A summarization of the treatments is presented in Table 3. A complete discussion of each treatment is included in the Methods and Materials section of the dissertation.

Regular Class

The regular class consisted of the entire population and was taught by the first instructor.

Extra Class

Members of the regular class were paired by the criteria given in Table 1. One member was randomly selected from each pair and assigned to the extra-class or treatment sessions. This group was termed the treatment group and received both Part I and Part II of the model.

Control Group

The control group was the group remaining after the treatment group was selected. This group received only Part I of the curriculum model.

Attendance

A. Regular Class: Attendance at regular class meetings was taken at one-third of the meetings.

B. Extra Class: Attendance was taken at all extra sessions by the second instructor. Students who attended 75% or more of the classes were considered to be in attendance regularly.

Achievement

Achievement was indicated by student grades. An "A" equaled four points, a "B" equaled three points, a "C" equaled two points, and a "D" equaled one point on a numerical scale. "F" equaled zero.

Attitudes Toward Agriculture

Attitudes toward agriculture were measured by an instrument developed in the course of this investigation. Responses to this instrument were factor analyzed and resulting factor scores were used as attitude measures. This procedure is discussed in detail in Chapter 2. A copy of the instrument appears in Appendix I. Informal feedback regarding the course and job interests were also used as a measure of attitude.

HYPOTHESES

Hypothesis One: H_1

Students exposed to Parts I and II of the curriculum model will have more favorable attitudes toward agriculture than will students exposed to only Part I of the model.

Hypothesis Two: H_2

Students exposed to Parts I and II of the curriculum model will have higher grades than will students exposed to only Part I of the model.

Hypothesis Three: H_3

Students exposed to Parts I and II of the curriculum model will have higher regular class attendance than will students exposed to only Part I of the model.

It was believed that the curriculum model would provide the student motivation referred to in the literature which would lead to the acceptance of the hypotheses.

Chapter 2

METHODOLOGY

In Chapter Two, a discussion of population selection, assignment, and characteristics is presented. Tables illustrating population characteristics are included. A detailed section on treatments and methodology follows the discussion of the population. A discussion of the instrumentation used in the study, including a factor analysis of the instrument, concludes the chapter.

SELECTION AND ASSIGNMENT OF SUBJECTS

The population consisted of forty-eight members of an introductory agronomy course taught by an associate professor of agronomy, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. This population was selected for several reasons: 1) the instructor was interested in curriculum development and was willing to cooperate in such a study; 2) an agronomy course contained a broad range of topics which were similar in nature to the material developed in the pilot study; and 3) the students represented a different background and orientation from those in the pilot study. A description of the population is reported in Tables I and II.

A modified pre-test post-test control group experimental design was used. A pre-test information and attitude questionnaire was administered to the students following the explanation for the study at the beginning of Fall Quarter, 1972. The same questionnaire was administered as a post-test at the end of the quarter (Appendix I).

Pre-treatment pairing of individuals was made from data derived from the pre-test questionnaire. Criteria used for pairing included

Table 1. A Summary of Population Characteristics by Percentages

POPULATION CHARACTERISTIC	No.	Per-cent	POPULATION CHARACTERISTIC	No.	Per-cent
RACE:			MARITAL STATUS:		
White:	48	100	Single:	41	86
Non-white:	0	0	Married:	7	14
SEX:			PROGRAM:		
Male:	45	94	Major:	16	33
Female:	3	6	Related Field:	28	58
			Elective:	4	8
MAJOR:			CLASS RANK:		
Science:	45	94			
Non-science:	3	6	Upper 1/4:	26	52
			Second 1/4:	15	33
CLASS:			Third 1/4:	2	4
			Lower 1/4:	0	0
Freshman:	6	13	Undetermined:	5	12
Sophomore:	20	42			
Junior:	15	31	Q.C.A. or		
Senior:	7	14	GRADE AVERAGE:		
BACKGROUND:			4.0-3.0	18	38
			2.9-2.0	19	40
Farm:	33	69	1.9-1.0	9	18
Non-farm:	15	31	Undetermined:	2	4

AGE:	Average Years		
	Male and Female	Females[a]	Males
Population:	20.4	20.4	20.5
Control:	21.4	24.0	20.7
Treatment:	19.4	19.0	20.3

[a]Only 3 females in population.

sex, class, age, class rank, farm background, Q.C.A., major or related field, and pre-test attitude scores. Individuals with like characteristics were paired, with each criterion being given equal weight in the pairing process. Paired individuals matched on an average of seven out of ten criteria (Table 2). Once paired, individuals were assigned at random from each pair, one individual was included in the treatment group and one in the control group.

TREATMENTS

Treatments consisted of eight one-hour per week sessions. A list of treatments is reported in Table 3. The treatments were initiated during the first week of the Fall Quarter, 1973, and were continued until the final week of the quarter.

The treatments were classified into three groups: (A) In-class Instruction, (B) Student Involvement Activities, and (C) Observation of Research and Practical Application. Some sessions included activities from more than one area. Each treatment was considered a prerequisite for the following one. Material presented in one session was generally applied in the next. Topics began with concepts of research and their application followed by introduction to facilities and equipment usage. These were followed by actual student implementation of experiments by the students, after which, they were able to observe other experiments of a similar nature which were being conducted at the Virginia Tech Turf Center for various segments of the turf industry. Data on the students' experiments were collected for several weeks, analyzed, and presented in the form of a class paper. The sessions were concluded with a section on soil sampling and application of soil information followed by a period

Table 2. Pairing By Background and Class Criteria

Group I: Control

Class	ID No.	No. Paired With	Sex	Class	Age	Married	Farm	[b]Class or H.S. Rank	Q.C.A. or H.S. Grade	Related Field (R) Major (M) Elective (E)	Sci.[d] Course	Total Attitude Score
Freshman	1	2	M	Fr.	18	No	Yes	25[c]	A[c]	R	C, B[c]	133
	3	4	M	Fr.	18	No	Yes	30[c]	A[c]	R	C, B[c]	131
	5	6	M	Fr.	18	No	Yes	10[c]	A[c]	E	C, B[c]	133
Girls	7	8	M[a]	Sr.	21	No	No	25	2.3	R	C, B Soils	139
	9	10	F	So.	24	No	No	24	1.8	R	B, C P, etc.	132
Sophomores	11	12	M	So.	19	No	Yes	10	1.5	M	C, B P	141
	13	14	M	So.	31	Yes	No	60	3.4	M	B, C etc.	143

[a]Only three girls in population. One male paired with one female based on other information.

[b]Refers to percentage of class; e.g. 10 means student was in top 10 percent of his class.

[c]Refers to high school rank, grade or subject.

[d]A = Agronomy, A.S. = Animal Science, B = Biology, C = Chemistry, P = Physics, Etc. = Others.

[e]No data.

Table 2. (continued)

Class	ID No.	No. Paired With	Sex	Class	Age	Married	Farm	Class or H.S. Rank	Q.C.A. or H.S. Grade	Related Field(R) Major(M) Elective(E)	Sci. Course	Total Attitude Score
Sophomores	15	16	M	So.	20	No	Yes	50	1.9	M	B, C A	137
	17	18	M	So.	19	Yes	Yes	30	3.1	R	B, C A	133
	19	20	M	So.	19	No	Yes	20	2.4	R	B	128
	21	22	M	So.	19	No	Yes	10	2.9	R	C	126
	23	24	M	So.	19	No	No	50	A [c]	M	C, B	138
	25	26	M	So.	19	No	Yes	10	3.6	R	B	120
	27	28	M	So.	30	Yes	No		C	R	B, C	118
Juniors	29	30	M	Jr.	24	Yes	Yes	10	1.6	M	C	134
	31	32	M	Jr.	20	Yes	Yes	50		M	C, B, etc.	138
	33	34	M	Jr.	20	No	Yes	30	1.9	R	B, C	135
	35	36	M	Jr.	20	No	No	60	2.3	M	C, B, etc.	134
	37	38	M	Jr.	24	No	Yes	40	2.0	R	C, B, etc.	128
	39	40	M	Jr.	21	No	Yes	--[e]	2.0	R		130
	41	42	M	Jr.	20	No	Yes	10	3.6	R	C, B, P, etc.	123

[a]Only three girls in population. One male paired with one female based on other information.

[b]Refers to percentage of class; e.g. 10 means student was in top 10 percent of his class.

[c]Refers to high school rank, grade or subject.

[d]A = Agronomy, A.S. = Animal Science, B = Biology, C = Chemistry, P = Physics, Etc. = Others.

[e]No data.

Table 2. (continued)

Class	ID No.	No. Paired With	Sex	Class	Age	Married	Farm	Class or H.S. Rank	Q.C.A. or H.S. Grade	Related Field(R) Major(M) Elective(E)	Sci. Course	Total Attitude Score
Seniors	43	44	M	Sr.	21	No	Yes	50	2.9	R	C, B, P,etc.	142
	45	46	M	Sr.	22	No	Yes	--[e]	2.6	R	C, B, etc.	135
	47	48	M	Sr.	22	No	No	30	B	E	B, C, etc.	126
			M	Sr.	21	No	No	10	2.3	R	C, B, P,etc.	124

Group II: Treatment Group

Class	ID No.	No. Paired With	Sex	Class	Age	Married	Farm	Class or H.S. Rank	Q.C.A. or H.S. Grade	Related Field(R) Major(M) Elective(E)	Sci. Course	Total Attitude Score
Freshman	2	1	M	Fr.	19	No	Yes	22[c]	B+[c]	R	C, B[c]	139
	4	3	M	Fr.	18	No	Yes	25[c]	A [c]	R	C, B[c]	124
	6	5	M	Fr.	17	No	Yes	20[c]	B [c]	R	C, B[c]	131

[a]Only three girls in population. One male paired with one female based on other information.

[b]Refers to percentage of class; e.g. 10 means student was in top 10 percent of his class.

[c]Refers to high school rank, grade or subject.

[d]A = Agronomy, A.S. = Animal Science, B = Biology, C = Chemistry, P = Physics, Etc. = Others.

[e]No data.

Table 2. (continued)

Class	ID No.	No. Paired With	Sex	Class	Age	Married	Farm	Class or H.S. Rank	Q.C.A. or H.S. Grade	Related Field(R) Major(M) Elective(E)	Sci. Course	Total Attitude Score
Girls	8	7	F	So.	19	No	No	10	3.2	M	B, C	163
	10	9	F	Jr.	19	No	No	20	2.6	R	B, C, P, etc.	122
Sophomores	12	11	M	So.	19	No	Yes	50	2.7	R	B, C, etc.	141
	14	13	M	So.	19	No	No	25	3.10	M	C	141
	16	15	M	So.	19	No	No	20	1.9	R	B, C, etc.	137
	18	17	M	So.	19	No	Yes	25	3.0	R	B, C	135
	20	19	M	So.	19	No	Yes	10	3.5	E	B, C	131
	22	21	M	So.	21	No	Yes	25	3.3	M	B	127
	24	23	M	So.	19	No	Yes	35	2.9	M	B	132
	26	25	M	So.	19	No	Yes	20	B	R	B, C, A, S, Hort.	124
	28	27	M	So.	25	No	No	10	1.7	R		120

[a]Only three girls in population. One male paired with one female based on other information.

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[c]Refers to high school rank, grade or subject.

[d]A = Agronomy, A.S. = Animal Science, B = Biology, C = Chemistry, P = Physics, Etc. = Others.

[e]No data.

Table 2. (continued)

Class	ID No.	No. Paired With	Sex	Class	Age	Married	Farm	Class or H.S. Rank	Q.C.A. or H.S. Grade	Related Field(R) Major(M) Elective(E)	Sci. Course	Total Attitude Score
Juniors	30	29	M	Jr.	26	Yes	Yes	10	3.4	R	C, B	136
	32	31	M	Jr.	20	No	No	10		M		152
	34	33	M	Jr.	20	No	Yes	--[e]	C[c]	M	B, C, P	137
	36	35	M	Jr.	20	No	No	50	3.0	M	C, B, etc.	134
	38	37	M	Jr.	24	Yes	Yes	50	2.4	M	C, B	123
	40	39	M	Jr.	21	No	No		1.8	M	C, B	129
	42	41	M	Jr.	20	No	No	50	3.0	R	B, C	128
Seniors	44	43	M	Sr.	21	No	Yes	50	3.0	E	B, C	140
	46	45	M	Sr.	22	No	Yes	--[e]	2.6	R	B, C, etc.	134
	48	47	M	Sr.	21	No	Yes	25	2.8	R	B, C, etc.	125

[a]Only three girls in population. One male paired with one female based on other information.

[b]Refers to percentage of class; e.g. 10 means student was in top 10 percent of his class.

[c]Refers to high school rank, grade or subject.

[d]A = Agronomy, A.S. = Animal Science, B = Biology, C = Chemistry, P = Physics, Etc. = Others.

[e]No data.

Table 3. Treatments Experienced by the Experimental Group

Treatment[a]	(A) In-class Instruction	(B) Student Involvement Activities	(C) Observation of Others' Research & Application
1. Introduction: Designs, Scientific Papers, Research Applications.	X		
2. Instrumentation for Agriculture Research. Plant Physiologist.		X	X
3. Greenhouse Orientation and Greenhouse Research, Staff.		X	X
4. Practical Application of Designs, Student Research.		X	
5. Small Plot and Field Research Techniques. Turf Center Director.			X
6. Data Collection and Interpretation. Research Results Presented in Scientific Paper Form.	X	X	
7. Sampling in Research--Soil Sampling. Soil Interpretation.	X	X	
8. Evaluation and Projection of Project.	X	X	

[a]Treatments are presented in order of administration.

of evaluation and projection of future projects of a similar nature. A more complete discussion of the treatments listed in Table 3 is given in the following paragraphs.

Introduction: Experimental Design, Scientific Papers, Research Application

Students were divided into Treatment and Control groups prior to the second regular class meeting. Those selected for the treatment group met at the end of the first week for their initial one-hour treatment session. During the hour, concepts and examples of experimental design were explained to the students by the second instructor. Scientific writing was discussed, journals and papers were reviewed, and applications of research principles cited. Students were given opportunity to ask questions concerning the concepts and value of the material. An attempt was made to generate enthusiasm at this session by showing the students how such material could be used by them as both homeowners and professional agriculture or research workers.

Instrumentation for Agriculture Research

The second week had two objectives. It gave the students their first opportunity to observe research conducted by other professionals and introduced them to the use of growth chambers, planimeters, CO_2 analyzers, light meters, and psycometers. A nationally known plant physiologist explained photosynthetic experiments being conducted in the growth chambers. While explaining the scope of the experiments, he indicated how each instrument was utilized in obtaining data. After each explanation, a demonstration on usage of the instrument was made. During the final twenty minutes, students practiced using the instruments and questions were answered on both the experiments and equipment.

Greenhouse Orientation

This session began with an explanation of greenhouse operations by the greenhouse superintendent. An orientation tour of the facilities followed. The last half of this session was conducted by personnel from various fields who were conducting greenhouse experiments. Students again combined observation of others' work with on-site training in using facilities.

Practical Application of Experimental Design: Student Research

During the fourth session, the students implemented their own research for the first time. This consisted of a simple randomized complete block design dealing with the effect of various mulches on the germination of different grasses. Students were divided into three groups, one per block, to set up the experiment. Material for the project was assembled prior to the class meeting which was conducted in the greenhouse by the second instructor. Directions for the procedures to be followed in setting up the experiment were given at the beginning of the class. Students were supervised throughout the class but assembled the entire experiment. The importance of replication, sources of experimental error, limitations in the interpretation of data, and application of results were stressed. Students discussed the experiment at the end of the period and made plans for maintenance and data collection which were carried out daily for three weeks.

Small Plot and Field Research Techniques

The proximity of the University Turf Center, where experiments were conducted for many segments of the turf industry, provided the students an opportunity to observe research similar to their own. As application of such research could be seen here, it was felt that this was a suitable follow-up to the students' research. Also, the Director was well-known in his field. Enthusiasm for an opportunity to hear a national authority was high and class attendance above the mean. Unfortunately, time conflicts caused the Director to miss the session which was subsequently conducted by the second instructor. Such problems, while rare, can and did cause some loss of enthusiasm.

Research Results Presented in Scientific Form

Since students were receiving no extra credit for the extra sessions, the decision was made to write a scientific paper as a class rather than as an individual project. Previous experience had indicated that with initial instructions students developed well-constructed papers both individually and in groups.

The period began with a review of scientific writing. Research data were evaluated and students were shown how to organize data for seminar and paper presentation. The students were then broken down into small groups to pool their data and develop sections. The sections were compiled into a final report. The report was reproduced and distributed to each student. A brief discussion of the paper, the research results, and practical applications of the experiment concluded the session.

Sampling In Research: Soil Sampling

Sampling is an integral part of research which is an essential but often neglected aspect of the student's training. Since almost all agricultural workers or homeowners eventually must take a soil sample, practical application was combined with research training in this class. Various sampling methods were discussed by the instructor, with different techniques being emphasized for various situations. The final part of the period was devoted to actual sampling.

Utilization of Soil Information: Evaluation and Projection of the Project

A slide presentation on soil use and interpretation concluded the treatments. Slides showed situations in research, agriculture, industry, recreation, and real estate developments where soil information was used. Emphasis was placed on how each student could utilize the knowledge gained in the course in his own situation, whether it be research, agriculture, or as a homeowner. This emphasis led to group evaluation of the strengths and weaknesses of such a program and how it could be integrated into the curriculum. (From this discussion, a high level of enthusiasm was perceived to exist for such a program.) This informal feedback was used along with grades and scores on the post-test to evaluate the success of the project. Such evaluation methods were considered justified, as both Cronbach (6) and Stake (30) have pointed out that both formal and informal evaluation techniques may be employed.

INSTRUMENTATION

The study was explained to the population in terms of research being conducted to improve teaching. It was explained that students, both current and future, were expected to benefit from the study as a result of improved curriculum and teaching methods. It was further explained that while one group, the treatment group, would have the benefit of an additional one hour of in-class experiences, the other, or control group, would have that time free for an extra hour of study. It was believed that such an explanation would lessen the Hawthorne Effect within and between treatment groups.

A pre-test information and attitude questionnaire, previously referred to in this chapter and included in Appendix I, was administered to the population during the first regular class meeting. Information from this questionnaire and total scores from the attitude section were used as criteria for pairing. The same instrument was given for the post-test to the entire population during the last regular class. The instrument attempted to determine attitudes toward the field of agriculture, the place research should occupy in an undergraduate course, and the perceived value of the course.

Questionnaire Development

The instrument was developed in cooperation with members of the doctoral committee, the Institutional Research Division of the University, and members of the statistics department. A review of the literature on attitude measurement and questionnaire development was made (1, 13, 15, 19, 25, 27, 32, 39). No model questionnaires for attitudes toward agriculture or science courses were discovered in the literature. General form and guidelines for a Likert-type attitude instrument as given by Guilford (15) and Ary (1) were followed. An attempt was made to develop questions which would indicate attitudes toward the field of agriculture, the role of research in undergraduate curriculum, and the student's perceived value of the course.

Scoring

The same scoring procedure was used for the forty-five questions which were identical for both pre- and post-test attitude sections of the instrument. Each question contained four possible answers: (1) Strongly disagree, (2) Disagree, (3) Agree, (4) Strongly agree. Each answer carried its numerical value in scoring. About equal numbers of positive and negative statements were included, with negative answers being scored as opposite positive ones; e.g. 1 = 4. A high total score indicated a positive attitude. Post-test scores were reported under five general categories of attitudes: A - Attitude Toward Course Content as Related to Agriculture as a Profession; B - Attitude Toward Course; C - Desirability of Agriculture as a Profession; D - Value of Basic vs Applied Knowledge; and E - Research Opportunities in Agriculture.

Questionnaire Administration

The pre-test questionnaire was administered to the entire population at the end of the first regular class period. The post-test was administered at the end of the last regular class period. No explanations regarding the necessity for completion of the questionnaire were given for either the pre-test or post-test situations other than to indicate that they would be used for administrative purposes. Instructions for answering questions were limited to requesting the students to answer every question, to answer it the best he could, and to be honest in marking choices. Students were assured that questionnaires would not be scored until after grades were calculated, and that the first instructor, who derived the grades, would not see the questionnaires until after the grades were determined. The questionnaire was administered by the second instructor. The first instructor left the room before the instrument was distributed and did not return until all tests were collected and scored and all pupils had left the room. Since the explanation for the study had been given to the population during the first regular class, no further explanation regarding the study were given at the time of the post-test.

Validity and Reliability of the Instrument

Because of the large number of factors produced by the factor analysis of the instrument, plus the discrepancy between pre- and post-test item assignment to different factors, (Tables 4, 5 and 6), some question existed regarding the instrument's validity. Since the factor analysis indicated that the instrument measured fifteen factors in the pre-test and fourteen in the post-test, the reliability of the instrument might also be questioned. As Ary (1) pointed out, an instrument may be reliable without being valid, but not valid if it is not reliable. If the reliability is in doubt, additional doubt is cast on the instrument's validity. Also, the instrument was implemented in this study without a previous factor analysis due to the necessity of conducting the study during the Fall Quarter, the only time the test course was offered. If pre- and post-tests had been given to a sample before and after they had taken some agriculture course, not necessarily one incorporating the model, this shift in pre- and post- attitudes may have been observed. Items which showed different pre- and post-test perceptions could have then been reworded or eliminated, another population tested, and the instrument reanalyzed.

However, the fact that some items were measuring different attitudes in the pre- and post-test was considered important in itself. This indicated that following the entire course, students had different perceptions than they had before taking the course. This in itself indicated that the course, although not necessarily the model alone, had caused some attitude change.

Factor Analysis

A factor analysis of the instrument was made to determine factor

Table 4. Fifteen Pre-Test Attitude Factors of Instrument as Determined by Principal Component Extraction, Varimax Rotation Factor Analysis, Showing Variables Assigned to Factors by Highest Loading Values and Categories of Combined Factors

Item[a] No.	Loading Value	Factor No.	Factor Heading	Factor Assigned to Category[b]
9 11 20*	.83 .62 .38	1	Agriculture as Profession and Course Relevance to Profession	A
13 36	.74	2	Attitude Toward Undergraduate Research and Course	B
22 23* 24 26 32	.60 .45 .75 .62 .68	3	Value of Research and Course Content to Profession	A
6 8 29	.51 .56 .79	4	Value of Research and Course to Agriculture Profession	A
1* 4	.46 .88	5	Desirability of Agriculture Profession	C
5 7 12 16 28 42	.68 .67 .74 .66 .71 .67	6	Research Opportunities in Agriculture	E
40* 19* 2 3*	.45 .47 .91 .42	7	Desirability of Agriculture as a Profession	C
15 17	.83 .83	8	Attitude Toward Course	B
27 31 41 43	.54 .52 .81 .69	9	Relationship of Course to Profession	A
37	.69	10	Basic vs Applied	D

*Denotes loading values $<.50$.

[a]A list of items is contained in Appendix I.

[b]Category titles:

A - Attitude Toward Course Content as Related to Agriculture as a Profession.
B - Attitude Toward Course.
C - Desirability of Agriculture as a Profession.
D - Value of Basic vs Applied Knowledge.
E - Research Opportunities in Agriculture.

Table 4 (continued)

Item[a] No.	Loading Value	Factor No.	Factor Heading	Factor Assigned to Category[b]
21 30* 38* 39	.78 .36 .46 .54	11	The Relation of the Course to the Profession	A
18* 34 35	.48 .83 .75	12	Attitude Toward Undergraduate Research	B
44 45	.74 .58	13	Method and Value of Course	B
14* 33	.40 .82	14	Value of Research vs Lecture in Teaching	B
10 25	.76 .52	15	Desirability of Agriculture as a Profession	C

*Denotes loading values <.50.

[a]A list of items is contained in Appendix I.

[b]Category titles:

A - Attitude Toward Course Content as Related to Agriculture as a Profession.
B - Attitude Toward Course.
C - Desirability of Agriculture as a Profession.
D - Value of Basic vs Applied Knowledge.
E - Research Opportunities in Agriculture.

Table 5. Fourteen Post-Test Factors of Instrument as Determined by Principal Component Extraction, Varimax Rotation Factor Analysis Showing Variables Assigned to Factors by Highest Loading Values and Categories of Combined Factors

Item[a] No.	Loading Value	Factor No.	Factor Heading	Factor Assigned to Category[b]
38*	.47		Students' General Attitude Toward the Course	
41	.74	1		B
43	.86			
45	.66			
12	.81		Desirability of Lecture vs Inquiry Method of Teaching--General Attitude Toward Course	
15*	.45			
16	.79	2		B
42	.83			
44	.82			
11	.53		Relationship of the Course to Agriculture as a Profession	
24	.68			
25	.67	3		A
29	.79			
30	.53			
31*	.41			
32	.80			
40*	.48			
9	.58		(Practical Aspect of Course.) Basic vs Applied Knowledge	
35	.81	4		D
37	.81			
39	.50			
22	.79		Research Opportunities in Agriculture	
27*	.49	5		E
28*	.45			
3*	.38		Research Opportunities in Agriculture	
4	.74			
6	.85	6		E
18	.53			
36	.60			
1	.89		Level Research Should be Carried out--Attitude Toward Course	
13	.61	7		B
34	.52			

*Denotes loading values <.50.

[a]A list of items is contained in Appendix I.

[b]Category titles:

A - Attitude Toward Course Content as Related to Agriculture as a Profession.
B - Attitude Toward Course.
C - Desirability of Agriculture as a Profession.
D - Value of Basic vs Applied Knowledge.
E - Research Opportunities in Agriculture.

Table 5 (continued)

Item[a] No.	Loading Value	Factor No.	Factor Heading	Factor Assigned to Category[b]
2 8	.82 .85	8	Value of Agriculture Courses	B
10 33	.81 .62	9	General Attitude Toward Course Content	B
5* 7 17	.46 .78 .64	10	Value of Research vs Practical Course Content	D
14	.85	11	General Attitude Toward Course	B
21	.85	12	Research Applied to Agriculture	A or D
19 23 26	.56 .71 .79	13	Attitude Toward Agriculture Research--Desirability of Agriculture Profession	C
20	.79	14	General Attitude Toward Course Research	B

*Denotes loading values <.50.

[a]A list of items is contained in Appendix I.

[b]Category titles:

A - Attitude Toward Course Content as Related to Agriculture as a Profession.

B - Attitude Toward Course.

C - Desirability of Agriculture as a Profession.

D - Value of Basic vs Applied Knowledge.

E - Research Opportunities in Agriculture.

Table 6. Comparison of Pre- and Post-Test Assignment of Items to Categories

Category Heading	Designation
A	Attitude toward course content as related to agriculture as a profession.
B	Attitude toward course.
C	Desirability of agriculture as a profession.
D	Value of basic vs applied knowledge.
E	Research opportunities in agriculture.

Pre-Test Category	Post-Test Category	Item
C	B	1. Agriculture sciences make contributions to farmers, industry, and general society.
C	B	2. Agricultural sciences are no longer a desirable major.
C	E	3. Agriculture and related fields are desirable professions.
C	E	4. Agricultural sciences are progressive, compared to other fields.
E	D	5. Agricultural sciences provide research opportunities.
A	E	6. Agriculture does not encourage professional development.
E	D	7. Agriculture sciences can include theoretical and practical information.
A	B	8. There is little reason to get an agricultural education at the college level if one plans to return to farming.
A	D	9. Little can be accomplished in agriculture in terms of personal success or fulfillment.
B	B	10. Undergraduates seldom develop a professional attitude toward their major.
A	A	11. Professors in agricultural science courses are usually competent in their field.
E	B	12. Laboratories should be included in most undergraduate agricultural courses.
B	B	13. Research should be carried out by professors and graduate students rather than be a part of an undergraduate program.

Table 6 (continued)

Pre-Test Category	Post-Test Category	Item
B	B	14. Research and individualized study are better methods of obtaining knowledge than listening to lectures in survey courses.
B	B	15. Courses covering a broad range of subject matter are better taught by lecture methods.
E	B	16. Survey courses should have a lab for research and discovery as well as lecture.
B	D	17. Survey courses in agriculture should drop the lecture sections.
B	E	18. There is a place for undergraduate research of many kinds and levels in agriculture.
A	A	19. Agricultural research seldom has much practical application.
A	B	20. Laboratory work in undergraduate courses can never be actual research, but merely demonstration of principles.
A	A	21. Papers assigned in courses usually are "busy work" and have little relation to learning.
A	D	22. One can learn by viewing research done by professors and other professionals in an academic field.
A	C	23. Experimental designs are helpful in doing research.
A	A	24. Class research can be original research.
B	A	25. Class research will probably be meaningless or give such negative results that no explanation other than "student error" can be given for the results.
A	C	26. Negative experimental results means an experiment has failed.
A	D	27. Laboratory work should clarify or amplify material covered in lecture.
E	D	28. Laboratory work affects grades adversely, as time spent in the lab could be better used to study notes and the text.
A	A	29. Introductory courses usually have little practical value.
A	A	30. Lab experiences in a course such as this give better insight into agriculture as a profession.
A	A	31. Survey courses should have relevance to occupations and professions.

Table 6 (continued)

Pre-Test Category	Post-Test Category	Item
A	A	32. Survey courses such as this have relevance to research being done in the field.
B	B	33. Survey courses should only teach factual material.
B	B	34. Material covered in a course such as this would not be expected to be useful to the average homeowner.
B	D	35. Material covered in a course taught at this level should be useful to the average farmer.
B	E	36. Material covered in an introductory course should be useful in formulating simple, but original research.
D	D	37. This course should stress learning fundamental principles, rather than trying to show application of principles.
A	B	38. This course should increase my professional interest and awareness.
A	D	39. This course will help me in my occupation.
C	A	40. Survey courses should give an indication of work done at the graduate level.
A	B	41. This course will be interesting.
E	B	42. A survey course such as this should be taught by the lecture method only, with no lab.
A	B	43. This course will be rather useless.
B	B	44. A lab would improve this course.
B	B	45. Survey courses like this have little relation to a major program and should be electives only.

structure, thus permitting analysis of aspects of the attitude measure. This analysis was accomplished through use of the computer program BDM 08M program (9) which yielded a principal component extraction varimax rotation factor analysis.

The procedure was similar to that employed by Goolsby and Frary, described in Vol. Thirty, Number Two, of Educational and Psychological Measurement, which contains the following description of the procedure (14). "For each analysis, unities were placed in the diagonal of the inter-correlation matrix, and a principal component extraction was performed to the point at which Eigenvalues of less than 1.0 were encountered. A varimax rotation was performed for all factors corresponding to [these] Eigenvalues." The highest loading value in each row determined the factor under which the item for a given row fell.

Tables 4 and 5 show each item, its loading value, the factor on which the item fell, and the category to which the item was assigned. These five categories resulted from combining certain factors with similar topics under one heading. These topics were determined by examining the items from the instrument which fell under each factor. A title or subject heading was given each factor. Examination of these headings showed that several factors, such as factors one and four of the pre-test, related to a basic theme (Table 4). Factors pertaining to a similar theme were then combined into one of five major categories. The five categories were assigned titles, Tables 4, 5 and 6, which were believed to reflect the major areas of attitude the instrument was measuring. For example, in the pre-test analysis, items under factors one, three, four, and nine dealt with student attitudes toward the course as it related to agriculture as a profession. These factors were then combined into category "A" and titled, "Attitude Toward Course Content as Related to Agriculture as a Profession." Similar procedures were followed for both pre- and post-test instruments for categories "B", "C", "D", and "E". These were titled "Attitude Toward Course," "Desirability of the Agriculture Profession," "Value of Basic Versus Applied Knowledge," and "Research Opportunities in Agriculture," respectively, for both instruments. Factor headings, categories to which each factor was assigned and category headings are shown in Tables 4 and 5. The pre- and post-test categories into which each item fell are shown in Table 6.

Validity of the Procedure

Examination of Table 6 shows that certain items which fell under one category in the pre-test fell under another in the post-test. This indicates that a given question was measuring a different attitude in pre- and post-tests. However, examination of loading values for these items in each factor analysis shows these values to be relatively small, usually less than 0.55. An example of this is item number thirty-one, Tables 4 and 5. The loading value places it under factor nine in the pre-test and factor three in the post-test; however, both were finally placed in category "A" in both tests (Table 6). This was done because both factor nine of the pre-test and factor three of the post-test, factors under which the item fell respectively, refer to the relationship of the course to the agriculture profession. As this was the topic of category "A" for both pre- and post-tests, the item fell into this category in both tests. Loading values such as these, although the largest in a given row for a given factor, were usually a little larger than the second highest loading value for that row. Frequently, a high number in the pre-test would become the second or third highest in the post-test and the variable would usually fall under another factor. Combining the fourteen and fifteen respective factors into five main categories for both pre-test and post-test eliminated the discrepancies to some extent (Table 6). Despite the discrepancies, it was felt that the items under the factors which were combined to form a category related to a central theme, according to the researcher's perception, to a high enough degree to justify the combination. Post-test scores from the five categories were then used to determine the stated attitudes of treatment and control groups.

Validity of the Study

For reasons discussed in the Validity and Factor Analysis sections regarding the instrument, these reasons being primarily due to the high number of factors that the factor analysis indicated the instrument was measuring, a question existed about the instrument's validity. Similarly, the fact that the factor analysis indicated fifteen pre-test and fourteen post-test factors were being measured, some doubt existed about the instrument's reliability. Since the instrumentation is a component of internal validity of the design, any question about the internal validity of the instrument is a question about the validity of the design. This was especially true concerning the results and conclusions regarding Hypothesis 1 .

Internal Validity

1. Contemporary history and maturation: As both treatment and control groups were essentially similar and would be expected to undergo similar experience, other than the treatments, during the test period, student history was not considered an important factor in

determining outcome. Maturation over the relatively brief ten-week period was also deemed to be relatively unimportant.

2. Population selection: Table 2 indicated that the populations matched on an average of seven out of ten factors per member. Treatment and control populations were considered to be approximately equal.

3. Selection x maturation: Neither group would be expected to mature faster than the other. Similarities in both populations, plus initial pairing before random assignment to groups, were designed to eliminate this factor.

4. Experimental mortality: There were two individuals, Number 25 and Number 39, who dropped the course soon after the pre-test. Pre-test attitude scores were 120 and 130, which were comparatively low and average, respectively, when compared to the group. These individuals were paired with Number 26 and Number 40 with pre-test attitude scores of 124 and 129, respectively. Since both of the individuals who dropped the course were in the control group, the scores of their paired partners were not included in the post-test data. It was felt that by removing individuals with similar scores and characteristics from both groups, that even though the post-test sample would be smaller, that it would still represent a similar population. The same procedure was followed for three other individuals and their pairing partners, who did not complete the post-test. Examination of the data showed that two of these three individuals who did not complete the post-test were paired with girls of the treatment group. Since data from girls was not included in the final analysis, as three individuals were not considered a representative sample, the actual mortality was only three individuals, or a total of three pairs of data dropped from the original population.

It was believed that since the mortality appeared at random regarding pre-test scores, and since data from similar individuals was removed from both groups, that experimental mortality did not produce internal invalidity.

5. Testing procedure: Although ten weeks is a relatively short time when considering maturation, it is a fairly long time for carry-over effects from the pre-test to influence post-test scores. This aspect is not considered important.

6. Statistical regression: This is believed to have virtually no effect. No individuals were selected because of extreme scores. The sample was considered to be a representative one for the test population. Essentially equal numbers of high and low individuals were in both groups. Data in Table 11 indicated similar scores in both groups, with no clustering at the means.

7. Instrumentation: This is considered the most serious threat to internal validity of the design. It has been discussed in connection with instrument validity, as well as in the introduction to this section, and will not be discussed further.

External Validity

As noted in the delimitation of the study, the results and the study apply only to the students in an introductory agronomy class. Since a special arrangement for the study was made with the course instructor in order for the treatment group to be able to participate, the results should have limited applications. The recommendations for modifications of similar studies, discussed in the conclusions section, have more general application.

As has been discussed, the factor analysis cast some doubt about both the instrument's validity and reliability. Consequently, instrumentation appeared to be the one factor which could have jeopardized the internal validity of the study. If the recommended procedures for development of future instruments are used, as recommended in the discussion of this section, a major weakness should be removed from future studies. In fact, the development of a sound attitude-determining instrument would in itself be a contribution to social research.

Chapter 3

RESULTS

Hypothesis One, regarding attitudes, was basic to the thesis. Hypotheses Two and Three were supportive to Hypothesis One. All formal analysis, including the factor analysis of the instrument and its results, an expanded 54 item analysis which related background information on students to instrument scores, a multivariate analysis of variance, and other calculations, indicated essentially no difference between treatment and control groups regarding all hypothesis (Table 7).

Results from the expanded fifty-four item factor analysis, which included the background data on students, characterized the control group as having high scores on items 22, 41, 43 and 45 (Table 7). The first three of these were positive items. This was interpreted to mean that the control group had a slightly more positive attitude than the treatment group, at least on these three items. For example, since item number twenty-two dealt with the value of viewing others' research, an activity participated in by the treatment but not the control group, the treatment group apparently felt there was less value in this activity than did the control group. The treatment group's negative reaction may have been partly due to a weak presentation by those whose research they observed. The fact that the one researcher did not show up for the class may have been another factor contributing to the negative attitude of the experimental group. Items 41 and 43 were the most difficult to explain. Here the analysis indicated the control group was simply more interested and found the course more valuable than the treatment group. A reverse Hawthorne effect may have played some role here, as the treat-

Table 7. Items Characterizing Groups When Broken Down By Background, Group Assignment, Attendance, and Grades, When Determined at a Loading Value of .50 Level or Above

Variable Name	Characterizing Item No.	Loading Value	Characterizing Item
Control Group	22	.53	One can learn by viewing research done by professors and others. Professionals in academic fields.
	41	.76	This course will be interesting.
	43	-.81	This course will be rather useless.
	45	.72	Survey courses have little relation to major.
Sex (F)	23	.51	Exp. designs are helpful in...research.
Non-Married	None	None	-----
Seniors	27	.50	Lab work is good.
Age	None	None	-----
Farm	None	None	-----
Class Rank	None	None	-----
QCA	None	None	-----
Previous Sci. Courses	None	None	-----
Attendance	None	None	-----
Grades	None	None	-----

ment group received no extra hours credit for the time spent in the extra sessions. This aspect is discussed further in the Conclusions section. Item number forty-five, intended to be a negative question, may have been interpreted differently by the two groups. It was difficult to draw conclusions from this question. If anything, it indicated a more positive attitude for the control group.

With only three definite positive items, from forty-five, loading in favor of the control group at the .50 loading level, it is difficult to conclude that there was any real difference in attitude between the two groups.

The factor analysis showed no significant item loadings for either grades or attendance (Table 7). Also, the factor analysis showed no item loadings above the .5 level for such variables as marriage, age, farm-non-farm background, class rank, QCA or previous science courses taken (Table 7). Absence of such loadings indicated no significant correlation between these variables and any specific item or group of items.

A computerized multivariate ANOVA test of significance using a Wilks Lambda criterion for a test of within cell regression gave a P-value of 0.019 and an R-value of 0.975 in a test of roots one through fifteen. This indicated a significant pre-test post-test correlation as well as justified the use of the pre-test as a covariant.

A multivariate ANOVA using the Wilks Lambda criterion for significance for all fourteen post-test factors, plus grades and attendance, gave an F-value of 2.16 ($p = .14$) which indicated no significant difference between groups at the .05 level (Table 8). P-values from this analysis for individual factors indicated that factor number six

Table 8. Multivariate Tests of Significance Using Wilks Lambda Criterion

Tests of Roots	F	DFHYP	DFERR	P Less Than	R
1 Through 1	2.15	16.00	8.00	0.13	0.90

	Univariate F Tests			Standardized Discriminant Function Coefficients
Variable	F(1, 23)	Mean Sq.	P Less Than[a]	1
Attendance	0.01	0.03	0.90	0.25
CRSE Grade	0.55	0.18	0.46	-0.16
Factor 1 Pos	4.99	4.08	0.03	1.54
Factor 2 Pos	0.03	0.02	0.86	-0.70
Factor 3 Pos	0.67	0.52	0.42	-1.23
Factor 4 Pos	0.51	0.44	0.47	-0.92
Factor 5 Pos	1.28	1.01	0.26	-1.04
Factor 6 Pos	3.62	4.03	0.07	-0.97
Factor 7 Pos	1.67	1.00	0.20	0.58
Factor 8 Pos	0.42	0.56	0.52	0.85
Factor 9 Pos	1.18	1.34	0.28	0.07
Factor 10 Pos	0.20	0.14	0.65	0.17
Factor 11 Pos	1.40	1.36	0.24	-.050
Factor 12 Pos	0.00	0.00	0.98	0.25
Factor 13 Pos	2.60	3.08	0.12	-0.13
Factor 14 Pos	0.60	0.68	0.44	-0.25
Discriminant Scores				1
Contrast 1				-1.88

[a]All variables non-significant at .05 level except Factor 1.

Table 9. Means and Standard Deviations of Attendance, Course Grades, and Factor Scores for Treatment (Group I) and Control (Group II) Groups

Factor T			Attendance	Variable Crse Grade	Factor 1 Pos	Factor 2 Pos	Factor 3 Pos	Factor 4 Pos
I	20 OBS							
		M	8.25	2.75	-0.38	-0.04	0.16	-0.09
		SD	1.61	0.55	0.95	0.99	0.96	0.95
II	20 OBS	M	8.30	2.30	0.40	0.03	-0.24	-0.01
		SD	2.29	0.92	0.86	0.82	0.97	0.95

Factor T			Factor 5 Pos	Factor 6 Pos	Factor 7 Pos	Factor 8 Pos	Factor 9 Pos	Factor 10 Pos
I	20 OBS							
		M	0.22	0.12	-0.10	-0.15	0.09	0.01
		SD	0.91	0.83	0.77	1.17	0.95	0.96
II	20 OBS	M	-0.18	-0.12	0.14	0.18	-0.01	0.06
		SD	1.03	1.18	1.26	0.79	0.97	0.97

Factor T			Factor 11 Pos	Factor 12 Pos	Factor 13 Pos	Factor 14 Pos
I	20 OBS					
		M	0.04	0.09	0.07	-0.12
		SD	1.14	0.76	1.41	1.06
II	20 OBS	M	-0.13	-0.03	-0.09	0.13
		SD	0.97	1.22	0.91	0.92

Complete Factorial With No Missing Cells.

Table 10. Estimates of Attendance, Course Grade, and Factor Scores Adjusted for 15 Covariates

Contrast T	Criteria: Attendance	Course Grade	Factor 1 Pos	Factor 2 Pos	Factor 3 Pos	Factor 4 Pos	Factor 5 Pos
I [a]	-0.03 [b]	0.08	-0.38	-0.02	0.13	0.12	0.19
II							

Contrast T	Criteria: Factor 6 Pos	Factor 7 Pos	Factor 8 Pos	Factor 9 Pos	Factor 10 Pos	Factor 11 Pos	Factor 12 Pos
I	0.38	-0.18	-0.14	0.21	0.07	0.22	0.00

Contrast T	Criteria: Factor 13 Pos	Factor 14 Pos
I	0.33	-0.15

[a] No. I = Treatment Group
No. II = Control Group

[b] Number indicates amount and direction of adjustment for given group. Unlisted group has reciprocal figure and sign.

Table 11. Post-Test Category Scores

Category	A		B		C		D		E	
	T	C	T	C	T	C	T	C	T	C
Fr.	26	38	31	34	8	8	31	32	21	21
	31	32	36	36	9	8	31	28	19	18
	29	30	32	37	8	8	31	24	22	26
Avg.	28.6	33.3	33	36.3	8.3	8	31	28	21	21.5
Avg. Diff.[a]	4.7C[b]		3.3C		0.3T		3T		0.5C	
Total	86	100	99	107	25	24	92	84	62	65
Total Diff	14C		6C		1T		8T		3C	
Soph.	35	35	39	37	8	7	32	29	24	22
	32	32	43	42	8	8	32	30	20	22
	35	30	39	30	8	8	30	30	20	19
	28	30	40	31	8	8	23	26	20	21
	37	31	25	28	8	9	33	31	25	23
	27	24	34	34	8	8	33	31	21	21
Avg.	32.3	30.3	36.6	33.6	8	8	30.5	29.5	21.03	21.3
Diff.	2.0T		3T		0	0	1.0T		0.0-	
Total	194	182	220	202	48	48	183	177	130	128
Total Diff	12T		18T		0	0	6T		2T	
Juniors	28	24	26	32	7	8	27	30	19	18
	29	29	28	32	8	8	27	32	25	25
	32	32	30	33	7	8	27	28	26	27
	36	36	37	34	7	6	28	28	28	28
	35	30	40	38	9	9	31	32	22	22
	40	30	41	41	9	9	33	33	23	21
Avg.	33.3	30.1	33.6	35.0	6.8	8	28.8	30.5	23.8	23.5
Diff.	3.2T		1.4C		1.2C		1.7C		0.3T	
Total	200	181	202	210	47	48	173	183	143	141
Total Diff	19T		8C		1C		10C		2T	
Seniors	28	29	32	32	8	11	28	36	20	22
	30	36	32	44	7	7	30	30	18	28
Avg.	29	32.5	32	38	7.5	9	29	33	19	26
Diff.	3.5C		6C		1.5C		4C		7C	
Total	58	65	64	70	15	18	58	63	38	50
Total Diff	7C		6C		3C		5C		12C	
Totals (With Seniors)										
Avg.	31.6	31.1	34.4	34.6	7.6	8.3	29.8	29.8	21.9	22.6
Avg. Diff. $\bar{X}_A$	0.5T		0.2C		0.7C		0.0-		0.7C	
Total	538	528	585	589	135	138	506.0	507.0	373.0	384
Total Diff	10T		4C		3C		1C		11T	

[a] T "minus" C

[b] C or T indicates higher control or treatment group score.

Table 12. Comparison of Pre- and Post-Test Item Mean Scores for Control Group

Item	Mean	S.D.	S.E. of Mean	Sample
Control Group Pre-Test Scores				
1	3.5000	0.5130	0.1147	20
2	3.2000	0.6959	0.1556	20
3	3.4000	0.5026	0.1124	20
4	2.9500	0.6048	0.1352	20
5	3.3500	0.4894	0.1094	20
6	3.2500	0.5501	0.1230	20
7	3.1500	0.3663	0.0819	20
8	3.4500	0.6048	0.1352	20
9	3.5000	0.5130	0.1147	20
10	2.8500	0.5871	0.1313	20
11	2.9500	0.3940	0.0881	20
12	3.1000	0.5525	0.1235	20
13	2.9500	0.6048	0.1352	20
14	2.7500	0.7864	0.1758	20
15	2.4000	0.5982	0.1338	20
16	2.8500	0.6708	0.1500	20
17	2.1500	0.4894	0.1094	20
18	3.0500	0.5104	0.1141	20
19	3.4500	0.8256	0.1846	20
20	2.9000	0.6407	0.1433	20
21	2.7500	0.7864	0.1758	20
22	3.1000	0.5525	0.1235	20
23	3.0500	0.3940	0.0881	20
24	2.8000	0.5231	0.1170	20
25	2.8500	0.4894	0.1094	20
26	1.9500	0.3940	0.0881	20
27	3.4500	0.5104	0.1141	20
28	3.1000	0.6407	0.1433	20
29	3.1500	0.5871	0.1313	20
30	3.0500	0.5104	0.1141	20
31	3.0000	0.4588	0.1026	20
32	2.9500	0.3940	0.0881	20
33	2.8500	0.4894	0.1094	20
34	2.8000	0.5231	0.1170	20
35	3.2000	0.4104	0.0918	20
36	3.1500	0.4894	0.1094	20
37	2.7500	0.7864	0.1758	20
38	3.3000	0.4702	0.1051	20
39	3.2500	0.4443	0.0993	20
40	2.8000	0.6156	0.1376	20
41	3.0000	0.4588	0.1026	20
42	3.1000	0.6407	0.1433	20
43	1.7500	0.4443	0.0993	20
44	2.8500	0.7452	0.1666	20
45	2.8500	0.5871	0.1313	20

Table 12 (Continued)

Item	Mean	S.D.	S.E. of Mean	Sample
		Control Group Post-Test Scores		
1	3.8000	0.5231	0.1170	20
2	3.6000	0.7539	0.1686	20
3	3.4500	0.7592	0.1698	20
4	3.1500	0.4894	0.1094	20
5	3.4500	0.5104	0.1141	20
6	3.3500	0.5871	0.1313	20
7	3.3500	0.4894	0.1094	20
8	3.2500*	0.7864	0.1758	20
9	3.6500	0.7452	0.1666	20
10	2.8500	0.7452	0.1666	20
11	3.2000	0.5231	0.1170	20
12	2.9500*	0.8256	0.1846	20
13	3.0500	0.7592	0.1698	20
14	2.6500*	0.8751	0.1957	20
15	2.1500*	0.6708	0.1500	20
16	2.8500	0.8127	0.1817	20
17	1.8000*	0.5231	0.1170	20
18	3.1500	0.6708	0.1500	20
19	3.5500	0.5104	0.1141	20
20	2.8500*	0.7452	0.1666	20
21	2.8000	0.7678	0.1717	20
22	3.0500*	0.0648	0.1352	20
23	3.2000	0.5231	0.1170	20
24	3.0000	0.7947	0.1777	20
25	3.2500	0.6387	0.1428	20
26	1.3000*	0.4702	0.1051	20
27	3.3000*	0.5712	0.1277	20
28	3.1500	0.5871	0.1313	20
29	2.9500*	0.6048	0.1352	20
30	3.0500	0.6048	0.1352	20
31	3.3000	0.6569	0.1469	20
32	3.0500	0.5104	0.1141	20
33	2.6500*	0.6708	0.1500	20
34	3.1500	0.5871	0.1313	20
35	3.1500*	0.5871	0.1313	20
36	3.0500*	0.3940	0.0881	20
37	2.8500	0.6708	0.1500	20
38	3.0000*	0.5620	0.1257	20
39	3.2000*	0.5231	0.1170	20
40	2.7000*	0.8013	0.1792	20
41	2.9000*	0.9119	0.2039	20
42	2.8500*	0.9333	0.2087	20
43	1.6500*	0.5871	0.1313	20
44	2.8000*	1.1050	0.2471	20
45	3.0000	0.4588	0.1026	20

*Items indicate lower post-test scores.

Table 13. Comparison of Pre- and Post-Test Scores For Treatment Group

Item	Mean	S.D.	S.E. of Mean	Sample
Pre-Test Item Mean Scores				
1	3.7500	0.4443	0.0993	20
2	3.5000	0.5130	0.1147	20
3	3.5000	0.5130	0.1147	20
4	3.1000	0.6407	0.1433	20
5	3.5000	0.5130	0.1147	20
6	3.3000	0.6569	0.1469	20
7	3.3000	0.4702	0.1051	20
8	3.2000	0.8944	0.2000	20
9	3.4500	0.9445	0.2112	20
10	2.5000	0.6070	0.1357	20
11	3.1000	0.4472	0.1000	20
12	3.1500	0.5871	0.1313	20
13	3.0000	0.7255	0.1622	20
14	2.8000	0.7678	0.1717	20
15	2.1000	0.4472	0.1000	20
16	2.9500	0.7592	0.1698	20
17	1.8500	0.4894	0.1094	20
18	3.0500	0.6863	0.1535	20
19	3.4000	0.8826	0.1974	20
20	2.8000	0.6156	0.1376	20
21	2.5000	0.7609	0.1701	20
22	3.2500	0.5501	0.1230	20
23	3.1500	0.3663	0.0819	20
24	2.7000	0.8013	0.1792	20
25	2.7500	0.9105	0.2036	20
26	1.8500	0.7452	0.1666	20
27	3.3500	0.4894	0.1094	20
28	3.0500	0.6048	0.1352	20
29	3.2500	0.7864	0.1758	20
30	3.0500	0.6048	0.1352	20
31	3.0000	0.3244	0.0725	20
32	2.9500	0.3940	0.0881	20
33	2.5000	0.8272	0.1850	20
34	3.0000	0.5619	0.1257	20
35	3.2500	0.4443	0.0993	20
36	3.0000	0.6489	0.1451	20
37	2.9500	0.8256	0.1846	20
38	3.3000	0.5712	0.1277	20
39	3.2000	0.6156	0.1376	20
40	2.7500	0.4443	0.0993	20
41	3.0000	0.0000	0.0000	20
42	3.0500	0.5104	0.1141	20
43	1.6000	0.5026	0.1124	20
44	2.8500	0.5871	0.1313	20
45	3.0500	0.6048	0.1352	20

Table 13 (Continued)

Item	Mean	S.D.	S.E. of Mean	Sample
		Post-Test Item Mean Scores		
1	3.7000	0.7327	0.1638	20
2	3.7000	0.4702	0.1051	20
3	3.7000	0.4702	0.1051	20
4	3.3000	0.5712	0.1277	20
5	3.5500	0.5104	0.1141	20
6	3.4000	0.7539	0.1686	20
7	3.3000	0.4702	0.1051	20
8	3.5000	0.6070	0.1357	20
9	3.7000	0.4702	0.1051	20
10	2.8500	0.4894	0.1094	20
11	3.3000	0.4702	0.1051	20
12	3.1000 *	0.6407	0.1433	20
13	3.0000	0.6489	0.1451	20
14	2.6000 *	0.6806	0.1522	20
15	2.2000	0.5231	0.1170	20
16	2.8500 *	0.7452	0.1666	20
17	1.8500 *	0.4894	0.1094	20
18	3.0500	0.5104	0.1141	20
19	3.4000	0.5982	0.1338	20
20	2.9500	0.6048	0.1352	20
21	2.8000	0.8944	0.2000	20
22	3.3500	0.5871	0.1313	20
23	3.1500	0.4894	0.1094	20
24	2.8500	0.4894	0.1094	20
25	2.9500	0.6048	0.1352	20
26	1.5000 *	0.7609	0.1701	20
27	3.4000	0.5982	0.1338	20
28	3.1500	0.7452	0.1666	20
29	3.1000 *	1.0208	0.2283	20
30	2.9500 *	0.6863	0.1535	20
31	3.2000	0.5231	0.1170	20
32	2.9000 *	0.6407	0.1433	20
33	2.4500 *	0.8256	0.1846	20
34	3.0500	0.7592	0.1698	20
35	3.2500	0.8507	0.1902	20
36	3.2500	0.6387	0.1428	20
37	3.0000	0.5620	0.1257	20
38	3.3000	0.5712	0.1277	20
39	3.2000	0.6156	0.1376	20
40	2.7000 *	0.5712	0.1277	20
41	3.4500	0.5104	0.1141	20
42	2.8000 *	0.8944	0.2000	20
43	1.2500 *	0.4443	0.0993	20
44	2.8500	0.7452	0.1666	20
45	3.4500	0.6863	0.1535	20

*Items indicate lower post-test scores.

with a value of .07 was the only one that was close to significance in favor of the experimental group. This factor included items 4, 6, 18 and 36, all positive except number six (Appendix I). Factor 1 was significantly different at the .05 level, but not at the .01 level, in favor of the control (Table 8). Since no other factors were significant at even the .05 level, it was inferred that no real difference in attitude existed between the two groups. Table 9 shows a positive post-test mean factor score of eight of fourteen items in favor of the treatment group, while nine of fourteen factors favored the treatment group when adjusted for the fifteen covariates of the pre-test factors (Table 10). Since these data were part of the multivariate analysis referred to above, which gave a P-value of 0.14, such findings were also non-significant.

When factors were combined into categories, calculations showed that while the control group had higher total instrument scores of four, three, one, and eleven points for categories B, C, D, and E, respectively, the treatment group had a ten-point higher score in Category A (Table 11). Such variable results, as well as the small differences, tended to support the conclusion that no differences existed in attitudes between the two groups. This grouping by categories was merely another method of analyzing the data. Since results from this analysis were similar to that of the factor analysis and multivariate ANOVA, no further discussion of this section of the analysis was made. A discussion of each hypothesis is included in the following section.

Hypothesis One: H_1

Students exposed to Parts I and II of the curriculum model will have more favorable attitudes toward agriculture than will students exposed to only Part I of the model.

Topic data from the forty-five item instrument used to determine attitude for both treatment and control groups were factor analyzed. Highest item loadings of this factor analysis indicated that fifteen pre-test and fourteen post-test attitude factors were tested by the instrument. These factors were then combined into five general attitude categories for additional analysis. Results from the factor analysis, comparison of pre- and post-test item means, and calculations of category scores from the instrument indicated essentially no differences in attitude between treatment and control groups (Tables 11, 12 and 13).

Analysis of means for pre- and post-test groups indicated that the control group had lower post-test scores than pre-test scores on ten of forty-five items, while the experimental group scored lower on nineteen post-test items (Tables 12 and 13). This seemed to substantiate the findings of the factor analysis, which showed that the control group scored higher on positive items 22, 41 and had a high negative correlation with the negative item number 43 (Table 7). These combined results indicated that the control group appeared to have a slightly more positive attitude than did the treatment group. Also, the slightly higher total category scores for the control group in four of the five categories would seem to lend support to this view at first glance.

Closer examination of scores showed that differences were small and not consistent for all factors (Table 11). The small population, combined with the small difference in scores, helped to explain the lack of significance between attitude scores for the two groups.

While these explanations appeared to explain any apparent but not significantly higher attitudes in the control than in the treatment group, they do not explain why the reverse was not true. An attempt to do this will be made in the Conclusions chapter under the section dealing with informal data.

Hypotheses two and three will be discussed together. As they were both analyzed by the multivariate ANOVA and table references, points of discussion and conclusion are similar.

Hypothesis Two: H_2

Students exposed to Parts I and II of the curriculum model will have higher grades than will students exposed to only Part I of the model.

Hypothesis Three: H_3

Students exposed to Parts I and II of the curriculum model will have higher regular class attendance than will students exposed to only Part I of the model.

Both attendance and course grades were included in the multivariate ANOVA, which gave the non-significant p-value of 0.13 for the .05 level (Table 8) previously discussed under the Hypothesis 1 section. The treatment group had a mean grade point of 2.75 compared to 2.30 for the control group (Tables 9 and 14). Yet, while scores indicated a slightly higher achievement for the treatment group, based on grades, it was not a significant one.

Attendance was taken at only half or 10 of the 20 regular sessions, but again, no differences were found. The relatively high attendance of both groups might partially explain the lack of a significant difference here. While not significantly different, the control group had a higher attendance mean of 8.30 compared to 8.25 for the ten regular sessions at which attendance was taken (Tables 9 and 15). Data corrected for co-variants gave similar results (Table 10). The fact that the treatment

Table 14. Comparative Grades of Treatment and Control Groups

	Control					Treatment				
Grade	A	B	C	D	Dropped	A	B	C	D	Dropped
No.	1	11	6	4	2	1	14	9	0	0
Grade Value	4	3	2	1	0	4	3	2	1	0
Total Value	4	+33	+12	+4	+0	4	+42	+18	+0	+0
Accumulated Value: A + B	37		+12	+4	+0	46		+18	+0	+0
A + B + C		51		+4	+0		64		+0	+0
A + B + C + D			55					64		
	Adjusted For Covariants									
Mean			2.30[a]					2.75[a]		
S.D.			0.92					0.55		

[a]Not significant at .05 level when analyzed by multivariate ANOVA.

Table 15. Comparative Regular Class Attendance: Attendance Taken 10 Times or at Half of Total Sessions

Control		Treatment	
Class/G	Freshmen		Freshmen
Subject No.	No. times present in 10 class periods	Subject No.	No. times present in 10 class periods
1	10	2	8
3	10	4	5
5	9	6	8
Class:	Girls		
7	4	8	8
9	9	10	8
Class:	Sophomores	Class:	Sophomores
11	8	12	10
13	9	14	9
15	7	16	8
17	9	18	4
19	8	20	9
21	9	22	10
23	9	24	10
25	dropped	26	9
27	10	28	9
Class:	Juniors	Class:	Juniors
29	10	30	8
31	7	32	10
33	9	34	8
35	9	36	9
37	10	38	10
39	dropped	40	10
41	7	42	7
Class:	Seniors	Class:	Seniors
43	10	44	4
45	6	46	6
47	10	48	7
Group mean:	8.25	8.30	
SD :	1.62	2.29	

group attended the extra sessions each week might explain the lower regular class attendance.

All data from the factor analysis of the instrument and the multivariate analysis of variance of attitude factor scores, grades, and attendance indicated that no differences existed. Consequently, hypotheses which predicted that the model would improve attitudes, grades and attendance must be rejected.

Chapter 4

CONCLUSIONS

Conclusions and Discussion

Results from the factor analysis, the multivariate analysis of variance in which the pre-test was used as a covariant, and other calculations indicated that the model had no effect in improving attitudes, grades, and regular course attendance of the treatment group over the control. Consequently, all three hypotheses underlying the basic thesis of this study must be rejected.

No definite conclusions could be drawn regarding the thesis itself; namely, that motivated students would have higher grades, class attendance, and attitude scores than for non-motivated students. Data from this study did not show a specific degree of motivation for either group. Since the factor analysis indicated that different attitudes were being measured for both groups in the pre- and post-tests, it was believed that both groups increased their knowledge and broadened their perceptions of agriculture during the quarter. However, it was concluded that students exposed to the model showed no significant differences in motivation from those who were not exposed. This conclusion was drawn since the formal data indicated no significant differences in attitudes, grades, or class attendance between the two groups. Consequently, it was concluded that the model did not increase motivation.

Informal feedback was perceived to be somewhat more positive regarding the model's effect than were the formal data. Since this feedback was more in keeping with observations made in the pilot study, some importance was attached to this feedback.

<u>Hypothesis One</u>: H_1. From the results of the factor analysis and the multivariate ANOVA between groups, it was concluded that no significant differences existed in attitudes toward agriculture as measured by the instrument. Consequently, it must be concluded that the treatments had no effect on improving the attitudes of the treatment group. Hypothesis One must be rejected. Several reasons were offered for this lack of significant improvement in the treatment group's attitude.

First, the experiment was set up as an addition to a regular class rather than as the class itself as was done in the pilot study. No additional course credit was given to the students who were in the treatment group. While most of them could probably see long term benefits from the extra sessions as well as indirect relation to the regular course, there were undoubtedly a few who resented being put in this group. A reverse Hawthorne Effect may have been in operation with these students. Answers on the questionnaire which reflected a poor attitude may have been a method of retaliation for being put into the experimental group. As was previously pointed out with a small population, one or two low scores could affect the outcome of an entire group.

Second, the treatment sessions were not the prime concern of the students, but the regular course was. Short term benefits derived from the extra sessions were oriented toward improving the student's performance in the regular course. In the pilot program, the curriculum implemented in the extra session of this study was the basis for the entire pilot program. The students in the pilot program, in contrast to those in this study, were oriented toward total involvement in the entire program rather than having the program as a sidelight.

Third, only eight hours of class time was devoted to implementing the new methodology with the treatment group. This was equivalent to four lab periods of the pilot study. Such a brief exposure made it difficult to have a significant impact on either the grades or attitudes of the treatment group.

Finally, two instructors taught the course with the second or non-regular instructor teaching the extra session. As the second instructor was not in charge of the overall program, it was much more difficult to convey his enthusiasm and knowledge to a group he saw only once a week. This was in contrast to daily contact with students of the pilot program.

It was further concluded that the instrument designed to measure an attitude toward agriculture was not measuring one attitude, but several. This was concluded from results of the factor analysis which indicated that fifteen pre-test and fourteen post-test factors were being measured. Although these were combined into five categories, it was concluded that if a general attitude toward agriculture was being measured, this attitude was composed of at least five distinct categories. This result led to a question concerning the reliability and validity of the instrument as well as questioned the internal validity of the experiment itself.

The lack of any published questionnaires regarding attitudes toward agriculture, plus the fact that time did not permit the development and factor analysis of an instrument with a small group before it was used in the study may have led to these results. Refinement of any instrument which might be used in attitude determination was deemed essential if the study's validity is not to be questioned.

Hypothesis Two: H_2. It was concluded that no significant difference existed between groups regarding regular class attendance. Results from the multivariate ANOVA indicated no significant difference on attendance at the .05 level. Since the two groups were drawn from a heterogenous population and no differences were found to exist in attitudes, it would not be expected that one group would have higher attendance than another.

Hypothesis Three: H_3. It was also concluded that no significant difference existed in achievement based on grades for the two groups, since results from the multivariate ANOVA indicated no significant difference between the two groups' grades existed at the .05 level (Table 8). Other reasons for these conclusions were similar to those reasons given for Hypotheses One and Two. Namely, the experiment was an addition to a regular class while results from the pilot study came from students enrolled in regular courses. Consequently, treatment sessions were of secondary importance to the students in this study. Finally, only a total of eight hours was devoted to implementing the model in this study which was equivalent to only about four laboratory sessions in the pilot study. Since the second instructor had relatively brief contact with the students, it was difficult to cause major attitude changes in such short contact time.

RECOMMENDATIONS BASED ON CONCLUSIONS

Several conclusions were drawn from this study. Recommendations based on reasons given for the results were made for refinements to be made in future, similar studies. These recommendations are listed below. They were believed to be positive contributions to social research and testing and are considered positive, secondary results.

First, an insufficient amount of time was allotted to develop the pre-implementation aspects of the study, including the formulation of the questionnaire. It is recommended that a sample questionnaire be developed and administered to a small, heterogeneous population. A factor analysis should then be run on this questionnaire, revisions made, and the process repeated. After the questionnaire is developed in this manner, it might then be administered to a trial population, similar to those which would be in the main study. Again, a factor analysis should be run and final revisions made before the instrument is administered to the test population. A procedure of this nature might well take two to three quarters.

Selection of test populations should also be changed from the method employed. It is recommended that two similar classes, each at the same level, with similar, but independent populations, be selected for the study. One class would be the treatment and the other the control. This would give a truly random sample for both groups. A single-instructor should teach both groups. One group would use the regular curriculum and methodology employed in such a class. The test group would use the experimental techniques. Pre- and post-test attitude questionnaires, developed as outlined above, would be given each group. Grades, class attendance, and informal feedback would be employed to determine relative attitude and achievement levels of both groups. Selection of subjects by this method would be entirely at random and representative samples would be obtained. Since students would be in completely independent sections, no Hawthorne Effect nor a reverse effect where students would deliberately give negative answers as a means of retaliation for being put in a treatment group, should be present, as students need not know that they were part of a test. If an entire course were taught by one method, students would accept the methodology as that normally employed in such a course and would react to the course or program as a whole, rather than to a special technique or pilot program.

At least one semester or quarter should be used to conduct the tests, and preferably a year's sequence of courses should be used. Only over such an extended period, during which time students have continual contact with a program, could their attitudes and achievement be expected to be altered by specific methodology. During this time, sufficient money, laboratory and greenhouse space, as well as administrative backing for the entire program, should be given in order that a complete program, based on student involvement, could be developed.

In other words, to have any chance for success, such a program must be implemented as a series of regular credit courses, taught by a single instructor with experience in developing such a program. This way students would be interested in the program for its own value rather than as a side issue to another course. Such a program should be a coordinated lecture-laboratory one where principles presented in lecture could be confirmed in the lab and research results discussed in informal lecture sessions. Laboratories should be of a sufficient time period to make maximum use of local field trips. Financial backing of a scale which would allow two or three major state or regional field trips must be available. Included in the budgeting should be money for at least one student-run professional event such as a soil field day. At a minimum all of these factors must be present if the students are to be motivated by involvement in a total program. Practical application of such work, as well as major course principles, must be constantly stressed. Attempts to publish outstanding student work, even in regional or local journals, must be made if students are to see any reward for such endeavors. Immediate recognition for special accomplishments, such as the student-run seminars and field days, should be made before peer groups as well as other faculty members and sources outside the classroom. Occupational benefits of this independent approach to learning should also be impressed upon the student.

Emphasis on training students to establish a program of their own, while learning factual material and research techniques, is another method of motivating students and developing positive attitudes. Such attitudes and achievements must be rewarded by intrinsic and extrinsic means. Beneficial research must be recognized, encouraged, and enthusiastically supported by the instructor. Only through such involvement, lasting over a period of time, can attitudes and achievement realize a positive change.

Ideally, the study should be carried out over a two or three-year period in order to allow time for complete program development. This time span would allow for a more complete study with several test and control populations.

A possibility which is recommended is that an investigation of this type rely on informal data and observations to a limited extent. These processes and results should be reported in a more narrative form rather than as a formal, scientific report. Observations might include the amount and quality of student research, utilization of resources and equipment and practical application of concepts, student involvement with development and implementation of special activities such as field trips, student seminars and symposiums, and field days. Also, if the program is carried out over several years, the number of students who returned for information on course-related problems and the number who establish similar programs of their own could also be used as positive indicators. Reasons for this final recommendation will be given in the section of this chapter dealing with informal data.

It is believed that the incorporation of these recommendations would result in improved future studies.

Results and Discussion of Informal Data

Even though the results of this study resulted as they did, the researcher still has faith in the curriculum design. This faith is justifiable on the basis of the limitations mentioned above and such informal results as were obtained in both this study and the earlier study at Mary Washington College.

According to Stake (30) and Cronbach (6), both formal and informal data are important in evaluating certain forms of research. For this reason, plus the fact that it corresponded to observations made over a five-year period in which the pilot program was developed, considerable reliance was placed on informal data and feedback regarding attitudes as well as on formal data. This informal feedback indicated that a higher positive attitude existed for many members of the treatment group than was indicated by the formal data.

Considering that no extra credit was given for the extra class participation required of the treatment group, participation in the extra sessions appeared enthusiastic and attendance better than expected, considering the circumstances. A drop in attendance was noted only after a well-publicized speaker failed to appear for one of the sessions. As enthusiasm and expectations of this researcher had been high, a let-down following this situation was expected. Attendance slowly improved toward the end of the course as the incident was forgotten in view of passing time and new class activities.

Students expressed enthusiasm in being shown practical applications of research work. Almost every member contributed substantially to the establishment and maintenance of the group experiments. The experiments were well cared for. Data were complete and taken regularly, generally on a daily basis. Class assignments, such as literature reviews and data summarization, although mainly done during the extra sessions, were thorough and well done. Since no credit toward a grade was given for this work, such participation was taken as an indication that students felt that the activities were worthwhile.

Informal discussions, especially those regarding course-related jobs and professions, and expressed student enthusiasm were considered indications of positive attitude, even though it was recognized that students generally will say what they feel will please an instructor. Yet, genuine interest and enthusiasm seemed to exist among many of the students in the treatment group, although the degree of enthusiasm and actual interest was difficult to formally evaluate. Favorable student feedback concerning the extra sessions was expressed to the first course instructor even though he was not involved in the presentations. One student member of the experimental group subsequently became a research assistant for revaluation of materials which would be presented in the regular course the following year.

Favorable feedback from various levels was acknowledged by the administration for the College of Agriculture. A proposal for a permanent teaching position was made in order to establish the program on a full-time basis. Large budget cuts which occurred in the College at the time of the proposal prevented the establishment of the position. However, such administrative backing and belief in the program's potential was taken as a strong indication of the program's success. Alterations in the existing course series in which the tests were conducted have resulted directly and indirectly as a result of this study. Additional modifications along lines suggested by the concepts embodied in the thesis will continue to be made in the series, according to the instructor.

Lack of significant differences in the formal data was explained in several ways. It has already been noted that as the literature pointed out, many evaluations must rely heavily on informal data. Since such data were much more in keeping with observations and data of the pilot study, a high degree of importance was attached to the informal data. These informal data indicate that the thesis is one which should be further researched.

SUMMARY

A study to determine the effect a curriculum model based on research, professional activities, and practical application would have on student attitudes toward agriculture, grades, and class attendance was initiated as eight extra sessions to an existing course in the Department of Agronomy at Virginia Polytechnic Institute and State University, Blacksburg, Virginia, in the Fall Quarter of 1973.

Results of this study, which compared a treatment group, drawn from the class population and exposed to the model, to a control group, which consisted of the other half of the class, indicated that no significant differences existed on the test factors of the two groups. These results were obtained, in part, from a principal component extraction, varimax rotation factor analysis of questionnaire items and background data on students. This information came from a questionnaire designed by the researcher as an instrument to determine attitude. A multivariate ANOVA, which used pre-test attitude scores as a covariant for post-test attitude scores, was the principal test of the student's results. This analysis also verified that no significant differences existed for course grades or attendance of the two groups.

Since formal data concerning the model were not positive and was in contrast to observations made over a five-year pilot study at another institution, informal data were also considered. Such data were positive in nature and corresponded to data from the pilot study. However, it must be noted that perceptions of the researcher who developed the curricular design may have biased these informal findings.

Recommendations for modification of future similar studies were made based on an examination of the study and its results. Such

recommendations were considered to be positive contributions to social science research of this type.

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APPENDIX I

Questionnaire

I. Questions listed on this sheet are for the purpose of administration evaluation of this course for future course modification and improvement. They will not be seen by Dr. Carson, the instructor, until after the course is over and grades have been issued.

II. Please answer the following questions:

A. Name: ____________________

B. Sex: ____________________

C. Married: ____________________

D. Class: ____________________

E. Age: ____________________

F. Farm Background: ____________________

G. Class rank or high school rank: ____________________

H. Q.C.A. or H.S. grade avg.: ____________________

I. Is this course a major, related field, or elective?: __________

J. Previous science courses: ____________________

III. Answer the following questions by marking the appropriate blank on the answer sheet.

1. Strongly disagree
2. Disagree
3. Agree
4. Strongly agree

A. Example: __4__ Dating is enjoyable.

1. _____ Agriculture sciences make contributions to farmers, industry, and general society.
2. _____ Agricultural sciences are no longer a desirable major.
3. _____ Agriculture and related fields are desirable professions.

4. _____ Agricultural sciences are progressive, compared to other fields.

5. _____ Agricultural sciences provide research opportunities.

6. _____ Agriculture does not encourage professional development.

7. _____ Agriculture sciences can include theoretical and practical information.

8. _____ There is little reason to get an agricultural education at the college level if one plans to return to farming.

9. _____ Little can be accomplished in agriculture in terms of personal success or fulfillment.

10. _____ Undergraduates seldom develop a professional attitude toward their major.

11. _____ Professors in agricultural science courses are usually competent in their field.

12. _____ Laboratories should be included in most undergraduate agricultural courses.

13. _____ Research should be carried out by professors and graduate students rather than be a part of an undergraduate program.

14. _____ Research and individualized study are better methods of obtaining knowledge than listening to lectures in survey courses.

15. _____ Courses covering a broad range of subject matter are better taught by lecture methods.

16. _____ Survey courses should have a lab for research and discovery as well as lecture.

17. _____ Survey courses in agriculture should drop the lecture section.

18. _____ There is a place for undergraduate research of many kinds and levels in agriculture.

19. _____ Agricultural research seldom has much practical application.

20. _____ Laboratory work in undergraduate courses can never be actual research, but merely demonstration of principles.

21. _____ Papers assigned in courses usually are "busy work" and have little relation to learning.

22. _____ One can learn by viewing research done by professors and other professionals in an academic field.

23. _____ Experimental designs are helpful in doing research.

24. _____ Class research can be original research.

25. _____ Class research will probably be meaningless or give such negative results that no explanation other than "student error" can be given for the results.

26. _____ Negative experimental results means an experiment has failed.

27. _____ Laboratory work should clarify or amplify material covered in lecture.

28. _____ Laboratory work affects grades adversely, as time spent in the lab could be better used to study notes and text.

29. _____ Introductory courses usually have little practical value.

30. _____ Lab experiences in a course such as this give better insight into agriculture as a profession.

31. _____ Survey courses should have relevance to occupation and professions.

32. _____ Survey courses such as this have relevance to research being done in the field.

33. _____ Survey courses should only teach factual material.

34. _____ Material covered in a course such as this would not be expected to be useful to the average homeowner.

35. _____ Material covered in a course taught at this level should be useful to the average farmer.

36. _____ Material covered in an introductory course should be useful in formulating simple, but original research.

37. _____ This course should stress learning fundamental principles, rather than trying to show application of principles.

38. _____ This course should increase my professional interest and awareness.

39. _____ This course will help me in my occupation.

40. _____ Survey courses should give an indication of work done at the graduate level.

41. _____ This course will be interesting.

42. _____ A survey course such as this should be taught by the lecture method only, with no lab.

43. _____ This course will be rather useless.

44. _____ A lab would improve this course.

45. _____ Survey courses like this have little relation to a major program and should be electives only.

APPENDIX II

Course Outline

Plant Science

A Foundation Course

Course Objectives:

Upon completion of this course you will be able to:

1. Appraise the role of plant science in providing food, fiber and aesthetic values for man.
2. Contrast the problems and opportunities in the broad field of modern plant science.
3. Apply basic principles from various disciplines (such as chemistry, physics, math, genetics and economics) to the field of plant science and evaluate their use in solving plant science problems.
4. Choose areas for advanced study in the broad field of plant science that will be of particular interest to you.

Course Outline

I. Plants in Agriculture

    A. Plants and Man

    B. Trends in Crop Production (Regional and Worldwide)

II. Classification

    A. The Plant Kingdom

        1. Morphology of gymnosperms - angiosperm

        2. Binomial nomenclature

        3. Varieties, cultivar types

        4. Common names

    B. By Use, Class, and Grades Quality. Introduction to Concept of Grades and Classes as Aids to Marketing and Trade

C. Identification and Use of Simple Keys

III. Structure - What is a Plant?

A. Plant Organs and Their Function

1. Roots, stems, leaves, buds

2. Flower, fruits, seeds

B. Tissues and Their Function

1. Xylem, phloem, epidermis

2. Meristem, cambium, pith

C. Cell

1. Composition, organelles, division, enlargement

2. Mitosis

IV. Functions and Processes

A. Bioenergetics

1. Photosynthesis

a. General reactions

b. Energy and crop efficiencies

c. Measuring photosynthesis

d. Factors affecting

1. Environmental factors

2. Plant and crop factors

2. Respiration

a. General reactions

b. Factors affecting

c. Measuring respiration

3. Nitrogen Metabolism, Protein Synthesis, DNA and RNA

B. Chemical Constituents and Natural Regulators

V. Morphogenesis

A. Seeds

1. Quality

2. Technology

3. Germination; Seed dormancy, scarification stratification

B. Vegetative Development

1. Totipotency

2. Endogenous control of decodency of DNA, transcription, translation

3. Environmental control; bud dormancy, tropisms, photomorphogenesis

C. Reproductive Development

1. Floral evocation and induction; photoperiodism, vernalization

2. Formation and development of egg and sperm

3. Pollination

4. Syngamy

5. Fruit development

D. Senescence

1. Chemical changes

2. Abscission of organs

VI. Physical Environment

A. Light

1. Nature of total incoming radiation balance, re-radiation, other losses

2. Management of light

a. Photoperiodism

b. Phototropism

B. Temperature

1. Temperature and light effects. Heat transfer

2. High and low temperature injury and resistance

3. Hardening

4. Management of temperature

    a. Soil, climate, slope and aspect, water

5. Vernalization and heat unit concept

C. Soil

1. Origin formation profile

2. Natural body

    a. Horizons

    b. Physical aspects; color, texture, structure

3. Land Use

    a. Crop adaptation

4. Mineral nutrition - essential elements

5. pH-Lime

6. Fertilization facts and figures

7. Nutrient cycle

8. Biological nitrogen fixation

D. Water

1. Precipitation

2. Hydrologic cycle - infiltration percolation

3. Drought storage losses

4. Water absorption, movement, loss aeration

5. Water conservation

6. Run-off, erosion, and soil conservation

7. Moisture stress

E. Air

1. Carbon cycle

2. Pollution

VII. Biological Environment of Plants

A. Disease Caused by Organisms

1. Viruses, bacteria, fungi, nematodes

B. Injury Caused by Insects and Mites and Nematodes

C. Weeds, Classes and Competitive Effects

D. Protection and Control of Pests and Disease

1. Recognition of cause

2. Assignment of control method

VIII. Reproduction and Plant Breeding

A. Pollination and Double Fertilization

B. Mieosis

C. Genotype - Environment Interaction

D. Basic Genetic Principles Through Di-Hybrid Ratios

E. Natural Selection, Domestication, Centers of Origins

F. Historical Accomplishments; Corn, Rice, Wheat

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Signed Richard T. Wilfong

EVALUATION OF A CURRICULUM MODEL FOR THE BIOLOGICAL SCIENCES

by

Richard T. Wilfong

(ABSTRACT)

A study to determine the effects of a new curriculum model for the biological sciences based on practical application of material, student research, and professional activities, all designed to promote student interest and involvement in course content, was initiated as a supplement to an existing introductory agronomy course during the Fall Quarter, 1973, at Virginia Polytechnic Institute and State University. Based on a pilot program established by the researcher at another institution, the treatment included investigation of research procedures, student utilization of the greenhouse and advanced research equipment, implementation of experimental designs, sampling techniques, and seminars. It was hypothesized that students exposed to the model would have better grades, higher class attendance, and improved attitudes toward the course and toward the agriculture profession than students who were not exposed to the model. Attitudes were determined by answers given on an attitude questionnaire which was developed by the researcher. Differences in attitudes, grades, and attendance between the two groups were analyzed for significance by a multivariate ANOVA.

Results of this ANOVA showed that no significant differences existed at the .05 level for grades, attendance, and attitudes between the two groups. A factor analysis of the questionnaire indicated that various attitudes were tested, rather than a single attitude. However, resultant scores for five general attitudes believed to be determined by the

questionnaire indicated that no differences in attitudes existed between the two groups.

As a result of this study, it was concluded that the model, as implemented, had no effect on grades, class attendance, or attitudes. However, experience gained as a result of this study led to several major recommendations for refinements which would improve the validity and reliability of future, similar studies.