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THE EFFECT OF TEACHING METHOD OR STUDENT CHARACTERISTICS ON STUDENT ACHIEVEMENT OR ATTITUDE IN A BASIC COMPUTER PROGRAMMING UNDERGRADUATE COURSE IN AGRICULTURAL MECHANIZATION AT IOWA STATE UNIVERSITY

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The effect of teaching method or student characteristics on student achievement or attitude in a BASIC computer programming undergraduate course in agricultural mechanization at Iowa State University

by

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CHAPTER I. INTRODUCTION[1]

During the last two centuries, a few inventions have affected tremendously the American social and educational system. The electric light, the telephone, and the television were among these inventions. Now another, the computer, can be added to this list with the possibility of having as much or more impact on education and society as any of the preceding ones. Elbert (1984) reported:

> "Nationally, 45 percent of adults say that they can operate computers. Twenty-two percent say they use computers at work, while only nine percent have them in their homes." Iowa's computer literacy is "actually 36 percent of adults" (Elbert, 1984, p. 1 and 4).

Though a recent invention, computers are fast becoming a part of everyday life. They are beginning to have an impact, directly or indirectly, on everyone's daily activities. Anyone that pays federal income taxes, uses natural gas to heat their home, uses electricity for lighting, or uses the telephone to reach out and touch, are numbers on a computer. In addition, the time spent standing in the check-out line at the grocery store has been greatly reduced because of computer and laser-beam technology. Watkins (1982) stated:

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[1]As part of Project 2617 of the Iowa Agriculture and Home Economics Experiment Station, this research study was reviewed and approved by the Iowa State University Human Subjects Review Committee (see Appendix E).

"Computer-assisted shopping may become a part of the home of the future....With the recent availability of low price computers and interactive terminals for the home, the possibility of computer-assisted shopping may have moved closer. In theory one could order any time of the day or night" (Watkins, 1982, p. 242).

With the aid of computers, educational institutions, businesses, and government now handle a vast amount of information faster and more accurately. Most farmers have always had a reputation for quick adaptation of new technology and the computer is no exception. A Des Moines Register article, "Challenge to Agriculture: Look Ahead, Not Back" pointed out that farmers have already utilized this high technology to control costs and improve decision-making. One-third of the Iowa farmers know how to use a computer, and about half that many use computers in their work (Urban, 1984).

Legacy et al. (1984) reported:

"As microcomputers become economically and technically feasible for agriculturalists, microcomputing in agriculture will become a more common occurrence.

Just as the producer who knows the principles of tractor operations is in a better position to make tractor-related decisions, so is the computer-literate agriculturalist better able to use the microcomputer. The implications is that as the use of computers on farms and ranches increases, students in Colleges of Agriculture will need to understand how computers can be used in agriculture" (Legacy et al., 1984, p. 254).

Pournelle (1984) summaries the effect of computerization by stating:

"In the years immediately ahead, computerization will spread more rapidly than electricity did at the beginning of the century. The microcomputer will

> bring about a fundamental transformation of the ways we do business....The vast access of knowledge and quick decision making that the computer bestows will allow fewer managers to exercise far more control than is presently feasible" (Pournelle, 1984, p. 82).

Elementary and secondary schools are utilizing computers in both management and teaching. The number of schools using computers has greatly increased in the past few years. In 1983, according to Fiske:

> "Fifty percent of all high schools, 40 percent of junior high schools, and 20 percent of elementary schools were using microcomputers" (Fiske, 1983, p. 87).

As software and hardware improves, this trend will continue and computers will play an even greater role in education.

Colleges and universities have utilized computers in management, teaching, and research for several years. Student registration and grades are processed using computers. Research data are stored and analyzed using large mainframe computers. However, the growth of microcomputer usage is just beginning.

At Iowa State University, the departments within the College of Agriculture include Agricultural Education, Agricultural Economics, Agricultural Engineering, Agricultural Studies, Agronomy, Animal Technology, Forestry, Genetics, Horticulture, Journalism and Mass Communication, Plant Pathology, Seed and Weed Sciences, and Sociology. Presently, most undergraduate students in the College of Agriculture graduate having used or been exposed to the mainframe computer and a microcomputer. The microcomputer is often used as a "dumb" terminal to communicate with the university mainframe computer in order to perform a specific function. The microcomputer is used in the laboratory or classroom to record data, to perform calculations, to edit texts, and to perform other necessary functions uniquely adapted to the microcomputer.

The opportunities for student use of the microcomputer at Iowa State University are tremendous, but the opportunities to learn how to program and manipulate software have been very limited. Prior to 1983, no courses in the College of Agriculture were offered to teach microcomputer usage or microcomputer programming. Agricultural Mechanization 180X, a course in the Agricultural Engineering Department, was developed to meet the microcomputer programming need. It was offered as an experimental course for the first time in June, 1983. Other classes designed to teach microcomputer software usage or programming have since been developed.

Statement of the Problem

Extensive research has been conducted comparing computer-assisted instruction to other types of instruction. However, very little research has been conducted on the factors affecting the development of computer skills, achievement, or attitudes. In other bodies of knowledge, such as mathematics, chemistry, history, and English, there are known unique factors that affect attitudes, achievement, or skill development. These factors have not yet been identified for computer usage or programming in agriculturally related fields. In order for agricultural educators to use the computer as a learning tool, these factors need to be identified.

Purpose of the Study

This study was done to identify factors that affect student achievement or attitudes in a BASIC (Beginners All-Purpose Symbolic Instruction Code) computer programming course in the Agricultural Mechanization Department, College of Agriculture at Iowa State University. The specific objectives of this research were:

1. Determine if there is a significant difference in student achievement scores as measured by posttest knowledge scores when using microcomputer-assisted instruction compared to conventional instructional methods.
2. Determine if there is a significant difference in student achievement scores when comparing teaching methods and 28 different demographic characteristics of students.
3. Determine if there is a significant difference in student attitudes as measured by posttest attitude scores when using microcomputer-assisted instruction compared to conventional methods.

4. Determine if there is a significant difference in student attitude scores when comparing teaching methods and 28 different demographic characteristics of students.
5. Determine if there is a significant difference in achievement scores when comparing teaching methods and attitude scores.

The Agricultural Mechanization 180X course was chosen for this research project because it was the only microcomputer programming course within the College of Agriculture at that time. In addition, the researcher was already involved with the course as an instructor and instrumental in developing the course outline and materials. Agricultural Mechanization 180X emphasizes the BASIC microcomputer programming language for microcomputers. BASIC is the language used by most nonprofessional programmers to communicate with a microcomputer. It is the "most used computer language in the world" according to Legacy et al. (1984).

The study was conducted as part of Project 2617, Iowa Agriculture and Home Economics Experiment Station. Also, cooperating in the study were the Agricultural Engineering Department (Agricultural Mechanization area), Agricultural Education Department, and Mr. Michael Spangler, Adjunct Instructor with the Agricultural Engineering Department (as the second instructor in the course).

Many studies have compared teaching methods when using computer-assisted instruction in non-agricultural subject matter areas. Few studies have compared microcomputer-assisted instruction in agriculture to other teaching methods. At the same time, few studies have been conducted to identify the factors affecting student attitudes or achievements when using microcomputer-assisted instruction. This research project should contribute to that body of knowledge thereby aiding agricultural educators and other instructors when teaching microcomputer programming.

CHAPTER II. LITERATURE REVIEW

Presented in this chapter are research summaries which augment and establish the theoretical framework for this study. Included are summaries of research and published articles on computer-assisted instruction, factors affecting student achievement and attitudes when using computers, and the need for computers in agriculture and agricultural education.

There is a wealth of literature concerning the effects of computer-assisted instruction on student achievement and attitude; however, most of the studies are in disciplines outside of agriculture. Therefore, research studies are cited from other disciplines.

This chapter is divided into the following sections: (1) Justification for the Study, (2) Computers in Production Agriculture and Agribusiness, (3) Computers in Agricultural Education, and (4) Computers and Student Achievement and Attitude, and (5) Summary.

Justification for the Study

In relation to other educational aids, the computer is a relative newcomer. It has, until now, mainly been a companion in the classrooms and laboratories of disclipines that require a large quantity of data processing. Now, the majority of schools in the United States have one or more computers available for student use.

Agriculture is even more deeply involved in computer usage than is education, in that nearly every sector of agriculture is highly dependent on computerized data and information transfer. The microcomputer is becoming as common as the telephone to agriculture and agribusiness.

In vocational agriculture and agricultural education, there is a clear and present need to train students and educators on microcomputer usage. Fiske (1983) stated:

> "IBM has predicated that in the not too distant future 75 percent of the work force will need some computer skills to perform their jobs" (Fiske, 1983, p. 86-147).

More specifically, the need exists not only to train students and educators, but adults already involved in agriculture and agribusiness.

The body of knowledge concerning the computer as an agricultural education tool is, at present, very limited. If educators are to use the computer effectively and efficiently in teaching situations, this body of knowledge must expand and grow with added research. As noted by Borg and Gall (1983):

> "The major reason for educational research is to develop new knowledge about teaching and learning and administration. The new knowledge is valuable because it will lead eventually to the improvement of educational practice" (Borg and Gall, 1983, p. 4).

Tsai and Pohl (1983) pointed out that:

> "Clearly, researchers as well as practicing teachers should be concerned with not only the amount of material that a student has learned but also with attitudinal changes that may be taking place. We must suspect that CAI has some impact on generalized student attitudes: toward learning, education, quantitative methods, computers, etc. Further research, particularly of a longitudinal rather than cross-section nature, is needed here" (Tsai and Pohl, 1983, p. 66-70).

Nearly all educational research on computers has dealt with computer-aided instruction versus traditional methods of instruction. The results have not been conclusive. Research concerning factors that influence attitude or achievement in disciplines other than agriculture is minimal. Research concerning factors that influence attitude or achievement in agriculture is almost non-existent. Due to the shortage of relevant research, this literature review also examines the results of research from disciplines outside of agriculture.

Computers in Production Agriculture and Agribusiness

Production agriculture or farming isn't what it use to be. The day of keeping records in a shoe box is past. The computer has already replaced the shoe box and the paper ledger. Farming has become an information, management-oriented business. Sonka (1983) reports:

> "No longer is the ability to produce high yields a guarantee of financial success in farming. Rather financial management and business decision-making play an increasingly important role in the survival of the farm firm. ...the importance of information and the effectiveness of the system which provides information to the farm operator are greatly intensified" (Sonka, 1983, p. 15).

One of the keys to successful management of today's farm is the ability to acquire and use relevant information. According to Sonka (1983), that information varies from measurements of last year's yields to monitoring next fall's futures prices. Sonka also reports:

> "The economic pressures currently facing agricultural producers suggest that more, not less, information will be required in the future" (Sonka, 1983, p. xi).

Reiterating that opinion, Starling and Shewmaker (1982) also point out that:

> "Narrowing profit margins, escalating interest rates, fluctuating weather patterns, and increasingly tight money have made the need for more accurate data and analysis more critical than ever before for the proper financial management of individual farm and agribusiness operations" (Starling and Shewmaker, 1982, p. 11-12).

Today's successful farmer is indeed a business manager dependent on information from outside the farm. Information, according to The American Heritage Dictionary (1980), "is the communication of knowledge." Production records, maintainance reports, and other data generated on the farm are only data or records. When these data are utilized in decision-making, it becomes information. The computer is the most efficient information processor available to the farmer or agriculturalist today.

Sonka (1983) reports:

> "The computer can aid the farmer in may ways, such as maintaining and generating financial records, maintaining and analyzing production records, and monitoring equipment. It can also aid in financial and operational decision-making, including decisions concerning strategic assets and in marketing process" (Sonka, 1983, p. 206).

Recognizing this potential, Dobbins and Suter (1982) suggests that:

> "The next explosion of technology to affect the American farm family may well be the microcomputer. Some persons now foresee the impact of the microcomputer equaling that of the farm tractor in the 1930s" (Dobbins and Suter, 1982, p. 19).

A major benefit of the computer to the farm is that less time will be required to do the arithmetic; the totalling, the calculations, and the checking. More time will be available to analyze the problems and study the results. Dobbins and Suter also stated: "The real benefit is that the information required to make decisions will be more readily available" (Dobbins and Suter, 1982, p. 19).

As noted by Sonka (1983), the reasons and potentialities for computer usage in agribusiness are the same as for production agriculture. Maintaining and generating financial records, maintaining and analyzing production records, and monitoring equipment would be major uses. It would still aid in financial and operational decision-making, make decisions concerning strategic assets, and aid in the marketing process by monitoring marketing information, and through electronic marketing.

Sonka (1983) also noted that small computers are, for example, being adopted by agricultural lenders to provide guidance and advice to their farm and ranch clients. At the same time, some agricultural lenders are actively encouraging computer acquisition by their clients to aid their borrower's management process.

The computer, though it has immense potential as a production agriculture or agribusiness tool, is only part of the total information system. The software and hardware for the computer system are as important as the computer itself, but nothing is as important to the success of the system as the people resources. Sonka states, "The farmer, not the computer system, is the critical ingredient in the successful use of a computer on the farm" (Sonka, 1983, p. 5). Accordingly, these individuals and their children will either learn to use the computer on their own, or seek assistance from educational institutions, primarily the Colleges of Agriculture and their Extension Service.

Computers in Agricultural Education

Not too many years ago, many people said that computers would dominate education. It never happened! The purchase price made them inaccessible for most classrooms. However, there has been a resurgence in the use of computers in the classroom. Fiske (1983) reported that:

> "More than 23,000 of the 77,000 schools in the country had microcomputers in 1982. This represents 50 percent of all high schools, 40 percent of junior high schools, and 20 percent of elementary schools" (Fiske, 1983, p. 86-147).

The microcomputer has become an integral piece of equipment in many vocational agriculture and agricultural education classrooms. For the student, it is more than just an electronic flashcard; it is a vital instrument of the future. As agricultural jobs become more dependent upon the computer, students planning to enter agriculturally related employment must become familiar with computers. This statement has been echoed throughout the literature. To not address this critical instructional area short changes these students.

Sistler (1984) states:

> "Vocational agriculture programs have traditionally accepted the responsibility of preparing students for entry into production agriculture and agribusiness. When providing this service for an industry as technically advanced as agriculture, our secondary and post-secondary programs must become deeply involved in teaching the use and capabilities of various computerized decision-making aids" (Sistler, 1984, p. 194).

Computer usage involves more than robotic usage of software. Taylor and Woolverton (1980) contend that:

> "For students, both agriculture and non-agriculture, to be adequately prepared to function effectively in the 'computerized world' of the present and future they need a basic education in the principles and concepts of computers and related information technology" (Taylor and Woolverton, 1980, p. 36-40).

Because schools are supposed to train students for employment, it follows that they have a mandate to make sure that the students are comfortable in using this new technology, as noted by Fiske (1983). The responsibility to integrate this new technology into the classroom has brought on problems for teacher educators. Suddenly, the vocational agriculture teacher and the teacher educator, without any formal or informal training, are expected to use or teach this new technology. Beane (1969) found that student achievement was directly related to the instructor's knowledge of the subject matter. Therefore, as Russell

(1984) stated:

> "To operate a microcomputer effectively, instructors must acquire some basic skills in computer literacy. For example, instructors must know whether a computer software program is compatible with a particular type of hardware. They must have an understanding of the microcomputer commands to execute a computer program and to perform basic operations such as printing, data storage and retrieval, and running pre-programmed software" (Russell, 1984, p. 2).

The responsibility for educating these teachers falls on the shoulders of the teacher educators. Foster (1982) noted:

> "Vocational agriculture instructors will have to obtain in-service education in the use and programming of computers. Teacher educators will have to include computer instruction as part of preservice preparation of new vocational agriculture instructors and provide opportunities for established teachers to prepare for computer usage in agriculture" (Foster, 1982, p. 5-6).

Computers and Student Achievement and Attitude

Limited research has been conducted on the factors affecting student attitudes and achievement related to computers. This section reviews the literature in several academic areas including agriculture, mathematics, data processing, political science, and computer programming.

Agriculture

Russell (1984) conducted research to determine the effectiveness of microcomputer-assisted instruction when teaching farm management and agricultural marketing. His sample consisted of 112 secondary and post-secondary vocational agriculture teachers in Iowa enrolled in a microcomputer workshop. The research design was a pretest-posttest control group design.

Results of the experiment revealed no significant difference between computer-assisted instruction and the conventional teaching method when students were grouped by posttest scores for the farm management and agricultural marketing concepts, or agricultural marketing problems. However, there was a significant difference between the two teaching methods when students were grouped according to posttest scores for farm management problems. Russell (1984) also noted that there was no significant difference between teaching methods when the students were grouped by teaching experience, hours of classroom computerized instruction, or computer experience.

Russell (1984) concluded that the relationship between the student's knowledge of computers and student's ability to learn with computer-assisted instruction needs additional study. Also, the areas of study in vocational agriculture are extremely diversified; hence, additional studies are warranted in agriculture mechanics, animal science, agronomy, horticulture, and other subject areas to determine the effectiveness of the computer as an instructional aid.

Johnson (1983) conducted a study to evaluate the effectiveness of the microcomputer as a decision-making aid in teaching farm management. The effectiveness of using a microcomputer was evaluated by student attitude and knowledge of farm management principles. The population for the study consisted of the Winter Farm Operation Program students enrolled in a beginning farm management course in 1983. A posttest treatment and control group design was used with course sections randomly assigned to the treatment or control group.

Johnson (1983) concluded that students who planned to farm full-time scored higher on achievement measures than the other students, and that students with a higher grade point average scored higher on content questions compared to students with a lower grade point average. Johnson also found that the treatment did not significantly affect the students' knowledge of farm management principles, or attitude concepts toward farm management principles.

Mathematics

Friesen (1976) conducted research to determine if students with certain cognitive and affective characteristics attained higher achievement and attitude scores when comparing lecture-discussion and computer-assisted instruction methods. His sample consisted of 137 prospective elementary school teachers enrolled in a mathematics course. The subject matter concerned elementary probability theory. The cognitive characteristics were English ACT score, mathematics ACT score, grade point average, hours of mathematics, and pretest on probability. The affective characteristics were self-concept of ability in mathematics, mechanical comfort-discomfort, desire for teacher contact, independence in learning, and ease of learning.

Friesen (1976) found that students with good prior achievement in mathematics performed the best under both teaching methods. The mathematics ACT score and the pretest of probability accounted for most of the predictable variance in achievement. For the lecture-discussion group, self-concept of mathematics ability and mechanical comfort-discomfort accounted for a significant amount of the variance in attitude toward probability. For the computer-assisted instruction group, mathematics ACT score and pretest of probability accounted for a significant amount of the variance in attitude toward probability.

Friesen (1976) suggests that further study of student characteristics which determine attitude toward subject matter under different instructional treatments is warranted.

Rice (1973) compared three different teaching methods (traditional instruction, computer-assisted instruction, and programmed packets) for teaching concepts in a college freshman calculus class. The sample consisted of 55 students randomly divided among the three teaching methods. Subjects taught were limits, derivatives, and integrals of functional from the set of real numbers. He found that there were no significant differences among the three teaching methods for the concepts taught. He also noted that the results were based on a very small sample size and have limited generalization.

Kockler and Netusil (1974) conducted a study to determine if CAI, as a part of an undergraduate mathematics course, can change the students' attitude toward mathematics and if CAI can change the students' attitude.

They also compared knowledge gained by CAI students to students taught in a conventional lecture situation. A stratified random sampling technique was used for a control and treatment experimental design. The sample consisted of 62 students enrolled in a mathematical class for two quarters.

Using analysis of covariance, Kockler and Netusil (1974) determined that attitudes towards CAI improved significantly for students using CAI but not the control group. Attitudes toward mathematics were not significantly different for either group. They also found no significant difference in mathematics achievement between the control or treatment group.

Data processing

Using an experimental design, Rota (1981) compared the effects among traditional-lecture instruction, computer-assisted instruction, and lecture information supplemented with computer-assisted instruction on student achievement and student attitude toward computers and computer-assisted instruction in a data processing course. Rota determined that there were no significant differences in student achievement among the teaching methods as measured by test scores. Using a semantic differential scale, he also determined that all groups showed a positive attitude toward computer-aided instruction and the computer.

Similarly, in a study designed to determine differences in attitudes toward the computer and CAI versus the lecture-instruction, Rushinek et al. (1981) conducted research in a university undergraduate BASIC programming and electronic data processing class. They found that the experimental group demonstrated a more positive attitude toward the computer as compared to the control group. These same students expressed a more positive attitude toward the CAI than the lecture-instruction group.

Political science

Broh (1975) conducted research in an undergraduate university course in American Government. The purpose was to determine differences between lecture and computer-assisted groups on student achievement in political science, methodological concepts, and computer techniques. The researcher also wanted to determine differences in student attitude toward the college environment. Analysis of variance was used to test the differences between the control and treatment groups on student achievement, and a two-tailed test of significance was used to determine the direction of the attitude change.

No significant difference was found between treatment and control groups for student achievement in political science. There was, however, a significant difference concerning methodological achievement. The students using the computer-assisted instruction materials had significantly higher methodological achievement scores than did the control group. Student classification and sex did not influence methodological achievement. Similarly, high school standing, cumulative grade point average, and SAT admission scores were not significant. The computer-assisted instruction group demonstrated significantly higher achievement in computer techniques than the control group.

Computer programming

Research by Tsai and Pohl (1978) in a university undergraduate computer programming class revealed no significant difference in student learning achievement among three teaching methods--lecture instruction (LI), CAI, and lecture supplemented with CAI (LCAI). Student achievement was measured by quizzes and examination scores, home work assignment scores, and term project scores.

An analysis of variance failed to reveal any significant difference in student achievement among teaching methods when using either home work scores or term project scores. However, when student achievement was measured by either hour quiz scores or final examination scores, there were significant differences. The LACI, the CAI, and LI groups all showed significant differences when measured by hour quiz-type exams and final exam-type exams.

Tsai and Pohl (1978) concluded that the results of their study failed to support the findings of most previous research and that differences in learning achievement can be measurement specific. According to Tsai and Pohl:

> "Significant differences in learning achievement under different teaching learning environments may

> be detected only with certain types of performance evaluation instruments. This point has not been fully considered in the literature to date and may well account for some of the seemingly contradictory results among research studies" (Tsai and Pohl, 1978, p. 66-70).

Summary

The results of the research concerning the various forms of instruction with the microcomputer are relatively inconclusive. The results of the experiments appear to be a function of the measurement instrument and/or the subject matter being measured. The literature does, however, point out two factors that are important in relation to microcomputer usage; mathematics ability, and attitude toward computers.

Several suggestions for further study are mentioned repeatedly; (1) studies need to be conducted for a longer period of time, and (2) studies and/or instruments need to be replicated to insure reliability.

The results of the experiments in the literature contributed greatly to the development of this study.

CHAPTER III. METHOD AND PROCEDURES

This study was designed to identify factors that affect student achievement or attitudes in a BASIC computer programming course at Iowa State University.

This chapter describes the specific research procedures utilized and is divided into these sections: Population, Research Design, Description of Treatment, Instrumentation, Data Collection, Data Analysis, and Summary.

Population

The population for this study was comprised of the students in the College of Agriculture, and the sample was the students enrolled in the Agricultural Mechanization 180X course during Fall, 1983 and Spring, 1984 semesters. Classes were randomly assigned to either the experimental or control group. The number of students in each class is shown in Table 1. The instructors were randomly assigned to both experimental and control groups.

As shown in Table 1, there were 61 students in the control group and 42 students in the experimental group. This represents 1.9 percent of the total enrollment in the College of Agriculture for Fall, 1983 and Spring, 1984 semesters.

Research Design

A pretest-posttest control group design was used for this study (Leedy, 1980), with degrees of freedom determined by the number of categories for each test. The research design may be graphically illustrated as follows:

R	0_1	X	0_2
R	0_1		0_2

The symbols are explained as follows:

R — represents random assignment to the experimental or control groups.

0_1 — represents (1) a demographic survey designed to collect personal and situational information from the students, (2) a knowledge pretest designed to measure a student's knowledge of computers and BASIC language, and (3) a pretest attitude inventory designed to measure a student's overall attitude toward computers and computer use.

X — represents the treatment in which students were taught using CAI materials prepared by the researcher. Instructors were randomly assigned to control and experimental groups.

0_2 — represents (1) a knowledge posttest designed to measure a student's knowledge of computers and BASIC language, and (2) a posttest attitude inventory designed to measure a student's overall attitude toward computers and computer usage.

According to Leedy (1980), the pretest-posttest control group design is considered to be the old workhorse of traditional experimentation.

> "In it, we have the experimental group carefully chosen through appropriate randomization procedures and the

control group is evaluated, subjected to the experimental variable, and reevaluated. The control group is isolated from all experimental variable influences and is merely evaluated at the beginning and at the end of the experiment" (Leedy, 1980, p. 270).

According to Borg and Gall (1983), the following steps are involved in the pretest-posttest control group design:

1. Random assignment of subjects to experimental and control groups.

2. Administration of a pretest to both groups.

3. Administration of the treatment to the experimental group but not to the control group.

4. Administration of a posttest to both groups (Borg and Gall, 1983, p. 541).

Borg and Gall (1983) suggest that:

"If properly carried out, this experimental design controls for the eight threats to internal validity identified by Campbell and Stanley; history, maturation, testing, instrumentation, regression, selection, mortality, and interaction effects" (Borg and Gall, 1983, p. 541).

External validity, though, may be affected by an interaction of the pretest with the experimental treatment.

The Solomon four-group design would have been a more desirable research design for this study, as it tends to remove the Hawthorne effect from the experiment. The "Hawthorne effect" may result when an individual is aware that he is participating in an experiment which in turn may alter his performance. Leedy (1980) states that in terms of experimental designs, the Solomon four-group design is probably the most powerful experimental approach. Unfortunately, the small number of students and classes prevented using this design in this study.

Description of Treatment

Computer-assisted instruction materials (CAI) were developed by the researcher for use in the Agricultural Mechanization 180X class in conjunction with the research. The microcomputer programs were written for Commodore microcomputers (Agricultural Mechanization 180X uses mainly Commodore Vic 20's). Each program was stored on a floppy disk, as a self-contained tutorial, and designed to teach one command in the BASIC programming language. Only students in the experimental group were allowed to use the computer programs. Each program covered a definition, discussion of the command, examples of use, and problem examples of each command. An example is included in Appendix A.

Commands covered by the CAI materials were: (1) LOAD, (2) RUN, (3) LIST, (4) NEW, (5) CLEAR, (6) LET, (7) READ/DATA, (8) PRINT, (9) END, (10) INPUT, (11) GOTO, (12) arithmetic operators: +, -, /, *, exponents, (13) parentheses, and (14) relational operators: >, <, =, >=, <=, <>. These commands were covered in seven lessons during the lecture and laboratory periods in the same sequence in which they were covered in the text used in the class. A course outline is included in Appendix A to show the sequence of study for the course. No additional CAI materials were used in the experiment.

Experimental group

Each student in the experimental group had access to a Commodore microcomputer during class and during open-laboratory hours and was given free access to the CAI materials during these times. Assignments were made each class period. Individual help was given to the students, as requested, but no other formal teaching of these commands took place. Many of the BASIC commands in the CAI materials were also in the textbook used in the course.

The two instructors coordinated their teaching plans and efforts to insure that the materials were taught in the same format and time frame. The researcher (one of the instructors) attended the second instructor's classes to insure continuity.

Two classes were randomly assigned as experimental groups in the Fall of 1983, and three classes in the Spring of 1984 (Table 1). Instructors were randomly assigned to both experimental and control groups.

Control group

Students in the control group had the same access to the microcomputers as the experimental group. They did not, however, have access to the CAI materials at any time. All materials were taught in the traditional lecture format using the same textbook as the experimental group. The materials were taught in the same format and time-frame as the experimental group and additional help was given as requested. The instructors coordinated teaching in the same manner as for the experimental group.

Three classes were randomly assigned as control groups in the Fall of 1983, and three classes in the Spring of 1984 (Table 1).

Instrumentation

Three instruments were developed for this study: (1) the demographic survey, (2) the attitude inventory, and (3) the knowledge test. Each was pilot-tested with the students enrolled in Agricultural Mechanization 180X course during the Summer semester of 1983.

Demographic survey

The demographic survey was designed to obtain information from the students on situational and environmental factors that possibly would affect student attitude or achievement in the course. Each member of the researcher's graduate study committee received a copy of the instrument to evaluate and make suggestions for improvement. The instrument was redesigned and pilot-tested during the Summer of 1983 in the Agricultural Mechanization 180X course. There were 29 questions on the survey--22 multiple-choice and seven fill-in-the-blank questions.

After the demographic survey was pilot-tested, a few changes were made. The final demographic survey contained 28 questions--26 multiple-choice and two fill in-the-blank. It was administered to the students during the first session of each class. A copy of the demographic survey is included in Appendix B.

Attitude inventory

In order to measure a student's attitude toward computers and computer use, an attitude inventory was developed. It contained ten questions. A semantic differential scale was used for each question with five, seven-category responses per question. The bipolar adjectives used for the response categories were taken from those recommended by Osgood (1971). The adjectives were selected on the basis of their appropriateness for the question being answered. The positive adjectives were located on the right side of the scale, and the negative adjectives were on the left side. All questions and bipolar adjective-pairs were randomly arranged. Each member of the researcher's graduate study committee received a copy of the instrument for evaluation. It, too, was pilot-tested during the Summer of 1983.

After pilot-testing, the instrument was redesigned. Some questions were reworded, combined or omitted, and several bipolar adjectives were replaced with more appropriate ones. The final inventory had 18 questions for student response. It was administered to the students during first session of each class as a pretest and then again after four weeks as a posttest. Reliability of the instrument was calculated as part of the experiment and is described in Chapter IV. A copy of the attitude inventory instrument is included in Appendix C.

Knowledge test

An 18 question, short answer test was developed to measure student knowledge of BASIC programming and computer use. To insure content validity, it was reviewed by the graduate program of study committee and two additional persons who were knowledgeable concerning BASIC computer programming. It, too, was pilot-tested during the Summer of 1983 in the same course. The final instrument contained 20 questions. Each question was a multiple-choice with five possible responses per question.

The instrument was administered to the students during the first session of each class as a pretest and again after four weeks as a posttest. Students were not allowed to use the computer for the test. A test of reliability was calculated as part of the experiment and is described in Chapter IV. A copy of the knowledge test instrument is included in Appendix D.

Data Collection

All three instruments were administered at the beginning of the first class session. Students adding the course at a later date were not included in the experiment. The instruments were immediately collected upon completion by the student. The knowledge test and the attitude inventory were again administered as a posttest during the last session of the fourth week of class. Both instruments were graded by the researcher. The knowledge test was graded and a composite score calculated for each student. All test questions were weighted equally in determining the final score. The attitude inventory was also graded by the researcher with a composite score calculated for each student. Since a semantic differential scale was used, a weighted mean was determined for each question on the instrument.

Data Analysis

The data were coded and placed on a text-file using a word processing program on an Apple IIe microcomputer. The file was transferred via a modem to the computation facilities (WYLBUR) at the Computation Center, Iowa State University. The statistical software package, SPSSX was used to analyze the data (SPSSX User's Guide, 1983).

The following are descriptions of subprograms in the SPSSX program used to analyze data for this study. "FREQUENCIES" provided a table of frequency counts and percentages for the values of independent variables.

The subprogram, "ANOVA" provided an analysis of variance for a full factorial design. It tests for significant differences of group means. ANOVA can be modified through the use of continuous explanatory variables (covariates) to become an Analysis of Covariance. F statistics and the significance of F (probability values) are calculated from this program as well as cell means, eta and beta values, and R-squared values.

The 0.10 level of significance was selected as the alpha value for testing for significant differences.

"RELIABILITY" was used to perform an item analysis on the components of the additive scale found in the knowledge test and attitude inventory. Cronbach's Alpha value was calculated as a measure of reliability.

"FREQUENCIES, RELIABILITY, and ANOVA" were used to analyze the data for the knowledge test and attitude inventory. For the knowledge test, the knowledge posttest score served as the dependent variable. The knowledge pretest score was the covariate. The independent variables were: the 28 demographic characteristics analyzed individually, teaching method, and in some cases, the pretest attitude score. The same analysis was completed for the attitude score except that the posttest attitude score served as the dependent variable and the pretest attitude score as the covariate.

Summary

This study was conducted in conjunction with the Agricultural Mechanization 180X course in the Department of Agricultural Engineering at Iowa State University. The objectives of the study were to determine if a significant difference exists between student knowledge scores when grouped by demographic characteristics, attitude scores, or teaching method, and to determine if a significant difference exists between student attitude scores when grouped by demographic characteristics or teaching methods.

A pretest-posttest control-group design was used in the study. The tests were closely monitored by the researcher to insure proper administration of the tests and treatment between the groups. Classes were randomly assigned to experimental and control groups. All instruments were pilot-tested during the Summer of 1983. The data were statistically analyzed with the SPSSX software package using the computer facilities at Iowa State University.

Because of the possible low external validity of the design used and the limited degrees of freedom, the findings and conclusions of this study may not be generalized to other populations.

CHAPTER IV. FINDINGS AND DISCUSSION

The objective of this study was to identify selected student characteristics that affect students' attitude and/or achievement in a BASIC Programming class in the Agricultural Engineering Department at Iowa State University. The research involved the study of these characteristics and their significance to two dependent variables: (1) student achievement in a BASIC programming course, and (2) student attitude toward computers and computer use. Student achievement was measured with a knowledge examination administered as pretest and posttest, while student attitude was measured with an attitude inventory. Student characteristics were obtained using a demographic survey which was administered at the beginning of the first class. The treatment involved computer-assisted instruction while the control group was taught using conventional lecture-instruction methods. The population consisted of the students in the College of Agriculture, and the sample was the students enrolled in the Agricultural Mechanization 180X course during two successive semesters at Iowa State University. The classes were randomly assigned as experimental and control groups, for a total of 61 students in the control group and 42 students in the experimental groups (Table 1). The instructors taught experimental as well as control groups.

The results of the analysis of data are presented in the following sections: (1) demographic characteristics of the students participating in the study, (2) pretest and posttest knowledge scores, (3) pretest and

Table 1. Student enrollment in agricultural mechanization 180X and class assignments to either treatment or control group for the study

	Control Group	Experimental Group
Fall semester, 1983		
Section 1		6
2	10	
3	12	
4		10
5	8	
Spring semester, 1984		
Section 1		10
2		9
3	11	
4	9	
5	11	
6		7

posttest attitude inventory scores, (4) Cronbach Alpha test for reliability, (5) the effect of teaching method or demographic characteristics on knowledge posttest scores, (6) the effect of teaching method or demographic characteristics on attitude posttest scores, (7) the effect of pretest attitude scores on posttest knowledge scores, and (8) summary.

Demographic Characteristics of Students Participating in the Study

Twenty-eight student demographic characteristics were identified and included in a demographic survey. The survey can be found in Appendix B. Data were collected on the students' background, academic training and knowledge, computer experience, and occupational plans. It required approximately ten minutes for the students to complete the instrument. The results of the demographic data are found in Table 2.

Slightly more than 73 percent of the students participating in this study were raised on a farm, and more than 13 percent were raised in a rural area. As noted by variable Question 1, less than 13 percent were raised in a city. Since the course was limited only to College of Agriculture students, this would account for the high percentage of rural and farm backgrounds.

The results from variable Question 2 indicated that 50 percent of the students had no vocational agriculture training at the secondary level, 15 percent had three or less years, and 34 percent had four years of vocational agriculture. The mean number of years of vocational agriculture was 0.84 years with a standard deviation of 0.91.

Data were gathered on the students' best-liked subject, least-liked subject, and subject where they received the highest and lowest grade at the secondary level. These were identified as variables Question 3, Question 4, Question 5, and Question 6. Variable Question 3 shows that most students made the highest grades in mathematics, science, vocational agriculture, or industrial arts. Most students made the lowest grades in mathematics, English, history, or science (variable Question 4). The subjects students liked best (variable Question 5) were science (26%) and vocational agriculture (23%). The subjects least liked at the secondary level (variable Question 6) were English, mathematics, history, and science. Vocational agriculture or industrial arts were not the least liked by any of the students in this study.

The mean semesters of mathematics at the secondary level (variable Question 7) was 5.64 semesters, with a standard deviation of 2.07. The mean semesters of mathematics at the post-secondary level (variable Question 21) was 2.46 semesters with a standard deviation of 1.48. Over 50 percent had two or less semesters of post-secondary mathematics, and 80 percent had four semesters or less.

Approximately 1.9 percent had an average mathematics grade of "D" in grades 9 through 12, 26.2 percent had an average grade of "C", 44.7 percent had an average grade of "B", and 27.2 percent had an average of "A" as noted by variable Question 8. Similarly, variable Question 22 shows that 2.9 percent of the students had a "D" or less as a post-secondary average mathematics grade, 40.8 percent had a "C", 34.0 percent had a "B", and 20.4 percent had an "A". The mean of 3.73 was a "C" with a standard deviation of 0.82.

Since typing ability is important when working with a computer, data were gathered on the typing speed of the students. Variable Question 9 shows the number of students in each category of words typed per minute.

The mean number of words typed per minute was between 21 and 30, with a standard deviation of 1.70.

Variables Question 10 and Question 11 revealed that only 17.5 percent of the students' male guardian and 18.4 percent of the students' female guardian use a computer in their occupation.

The majority of the students in the study were upperclassmen as shown by variable Question 12. In fact, only 1.9 percent of the students were freshmen, 8.7 percent were sophomores, 25.2 percent were juniors, 61.9 percent were seniors, and 2.9 percent held other classifications. Variable Question 13 reveals the student major with the majority of the students being either in farm operations, dairy science, or ag business.

Approximately 77 percent of the students in this study had experience using computers as noted by variable Question 14. Variable Question 15 and Question 16 indicate the number of students in this study that had either formal microcomputer instruction or formal mainframe-computer instruction. Over 70 percent of the students had no formal microcomputer or mainframe-computer instruction.

Other statistics regarding computer experience showed that only two students owned a computer (variable Question 17) and only six students' parents owned computers (variable Question 18). All students in this study had experience using a basic calculator (variable Question 19) and over 75 percent had been using calculators for more than five years with a mean of 7.26 years and a standard deviation of 1.67. Less than 25 percent had one year or more of experience with a programmable calculator as noted by variable Question 20. The mean years of programmable calculator experience was 0.24 with a standard deviation of 0.43.

Variable Question 23 shows that over 85 percent of the students in this study had played video games, with 46.6 percent having played between one and ten hours, 22.3 percent between 11 and 50 hours, and 13.6 percent more than 50 hours.

Previous employment contributed to student interest in computers for slightly more than 26 percent of the students as noted by variable Question 24.

Employment plans after graduation varied widely among the students. Almost 39 percent of the students planned to farm after graduation, and the majority of the rest planned to enter an agricultural business (variable Question 25).

Variable Question 26 shows that the largest percentage of the students took the course for personal interest, with the lack of computer experience being the next largest category. Variable Question 27 indicates that 71.0 percent of the students were enrolled by their own choice, 23.0 percent were influenced by their advisors, and 6.0 percent were influenced by someone else.

Over 48 percent of the students rated their command of English as "average", while almost 45 percent rated themselves as above average (variable Question 28). Command of the English language is crucial to computer programming. At the beginning of the course, there were

Table 2. Demographic characteristics of the students enrolled in agricultural mechanization 180X during the study period

Independent Variable	Variable Description	Value	Frequency	Total %	Mean	Standard Deviation
Question 1	Student Background				1.38	.70
	Farm	1	76	73.8		
	Rural	2	14	13.6		
	City	3	13	12.6		
Question 2	Semesters of Vo Ag Grades 9-12				.84	.91
	0	0	52	50.5		
	1-3 years	1	16	15.5		
	4 or more years	2	35	34.0		
Question 3	Highest Grade Subject Grades 9-12				3.63	2.24
	Math	1	25	24.3		
	Science	2	21	20.4		
	History	3	8	7.8		
	English	4	9	8.7		
	Physical Education	5	6	5.8		
	Vocational Agriculture	6	21	20.4		
	Industrial Arts	7	13	12.0		
Question 4	Lowest Grade Subject Grades 9-12				2.89	1.60
	Math	1	29	28.7		
	Science	2	11	10.9		
	History	3	23	22.8		
	English	4	29	28.7		
	Physical Education	5	3	3.0		
	Industrial Arts	6	1	1.0		
	Other	7	5	4.9		

Question 5	Best Liked Subject Grades 9-12				4.21	2.29
	Math	1	13	12.6		
	Science	2	26	25.2		
	History	3	6	5.8		
	English	4	4	3.9		
	Physical Education	5	9	8.7		
	Vocational Agriculture	6	23	22.3		
	Industrial Arts	7	17	16.5		
	Other	8	3	2.9		
Question 6	Least Liked Subject Grades 9-12				3.28	1.71
	Math	1	22	21.4		
	Science	2	7	6.8		
	History	3	22	21.4		
	English	4	40	38.8		
	Physical Education	5	5	4.9		
	Other	6	6	5.8		
Question 7	Semesters of Math Grades 9-12				5.64	2.07
	1	1	1	1.0		
	2	2	7	6.8		
	3	3	12	11.7		
	4	4	14	13.6		
	5	5	9	8.7		
	6	6	24	23.3		
	7	7	6	5.8		
	8	8	27	26.2		
	9 or more	9	3	2.9		
Question 8	Average Math Grade Grades 9-12				2.97	.79
	D	1	2	1.9		
	C	2	27	26.2		
	B	3	46	44.7		
	A	4	28	27.2		

Table 2. (Continued)

Independent Variable	Variable Description	Value	Frequency	Total %	Mean	Standard Deviation
Question 9	Typed Words Per Minute				2.78	1.70
	0	0	13	12.6		
	1-10	1	10	9.7		
	11-20	2	23	22.3		
	21-30	3	20	19.4		
	31-40	4	22	21.4		
	41-50	5	9	8.7		
	51-60	6	5	4.9		
	61-70	7	1	1.0		
Question 10	Male Guardian Used Computer				1.18	.38
	No	1	85	82.5		
	Yes	2	18	17.5		
Question 11	Female Guardian Used Computer				1.18	.39
	No	1	84	81.6		
	Yes	2	19	18.4		
Question 12	Student Classification				3.54	.78
	Freshman	1	2	1.9		
	Sophomore	2	9	8.7		
	Junior	3	26	25.2		
	Senior	4	63	61.2		
	Other	5	3	2.9		
Question 13	Student Major				4.43	1.93
	Ag Mechanics	1	5	4.9		
	Fish Wildlife	2	7	6.8		
	Farm Operations	3	35	34.0		
	Horticulture	4	7	6.8		
	Dairy Science	5	11	10.7		

	Ag Business	6	26	25.2		
	Agronomy	7	6	5.8		
	Ag Economics	8	3	2.9		
	Forestry	9	3	2.9		
Question 14	Computer Experience				2.05	.78
	None	1	26	25.2		
	Little	2	49	47.6		
	Some	3	25	24.3		
	Much	4	3	2.9		
Question 15	Have Had Microcomputer Instruction				1.31	.47
	No	1	71	68.9		
	Yes	2	32	31.1		
Question 16	Have Had Mainframe Computer Instruction				1.27	.45
	No	1	75	72.8		
	Yes	2	28	27.2		
Question 17	Own a Microcomputer				1.02	.14
	No	1	101	98.1		
	Yes	2	2	1.9		
Question 18	Parent Computer Ownership				1.06	.24
	No	1	95	92.2		
	Yes	2	6	5.8		
			2	1.9		
Question 19	Years of Basic Calculator Experience				7.26	1.67
	5 or Less	5	23	22.3		
	6	6	12	11.7		
	7	7	18	17.5		
	8	8	25	24.3		

Table 2. (Continued)

Independent Variable	Variable Description	Value	Frequency	Total %	Mean	Standard Deviation
	9	9	10	9.7		
	More Than Nine	10	13	12.6		
			2	1.9		
Question 20	Years of Programmable Calculator Experience				.24	.43
	Less Than 1	0	78	75.7		
	More Than 1	1	24	23.3		
			1	1.0		
Question 21	Post-Secondary Semesters of Math				2.46	1.48
	1	1	29	28.2		
	2	2	35	34.0		
	3	3	17	16.5		
	4	4	11	10.7		
	5	5	3	2.9		
	6	6	3	2.9		
	More Than 6	7	3	2.9		
			2	1.9		
Question 22	Post-Secondary Average Math Grade				3.73	.82
	D and Less	2	3	2.9		
	C	3	42	40.8		
	B	4	35	34.0		
	A	5	21	20.4		
			2	1.9		

Question 23	Hours on Video Games				1.36	.91
	0	0	15	14.6		
	1-10	1	48	46.6		
	11-50	2	23	22.3		
	More Than 50	3	14	13.6		
			3	2.9		
Question 24	Computer Interest from Employment				1.27	.44
	No	1	75	72.8		
	Yes	2	27	26.2		
			1	1.0		
Question 25	Occupational Plans				4.04	3.15
	Farming	1	40	38.8		
	Farm Management	2	9	8.7		
	Ag Mechanics	3	2	1.9		
	Ag Sales and Service	4	8	7.8		
	Ag or Extension Education	5	3	2.9		
	Ag Business	6	19	18.4		
	Forestry	7	1	1.0		
	Fish Wildlife	8	9	8.7		
	Administration	9	2	1.9		
	Other	10	9	8.7		
Question 26	Factor Influence to Take Course				1.96	1.30
	Personal Interest	1	47	45.6		
	Lack of Computer Experience	2	35	34.0		
	Degree Requirements	3	7	6.8		
	Curiosity	4	3	2.9		
	To Learn Basic	5	6	5.8		
	Other	6	3	2.9		
			2	1.9		

Table 2. (Continued)

Independent Variable	Variable Description	Value	Frequency	Total %	Mean	Standard Deviation
Question 27	Who Influenced To Take Course				1.35	.59
	Myself	1	71	71.0		
	Advisor	2	23	23.0		
	Others	3	6	6.0		
Question 28	Command of English Language				3.43	.62
	Poor	1	1	1.0		
	Below Average	2	3	2.9		
	Average	3	50	48.5		
	Above Average	4	46	44.7		
	Superior	5	1	1.0		
			2	1.9		

several international students enrolled. Because of language differences, all international students, with one exception, dropped the course before the end of the experiment due, in their words, to frustration because of language differences.

Pretest and Posttest Knowledge Scores

The knowledge test was composed of 20 multiple choice questions designed to test the students' knowledge of computer usage and BASIC programming. It was administered as pretest and posttest and required approximately 20 minutes to complete. Each test was graded by the researcher with each question having equal weight toward the final score. A composite score was determined for each test for each student in the study. The knowledge test can be found in Appendix D.

As indicated in Table 3, there were a total of 103 students participating in this study. The mean for the pretest knowledge examination was 25.78 with a standard deviation of 13.81. Over 96 percent scored below 50 percent on the pretest knowledge examination and over 58 percent scored below 25 percent. The low knowledge test scores for the pretest were not surprising. Most students in the course had little or no computer training or experience, particularly in BASIC programming. Table 4 shows that the posttest knowledge examination score mean was 55.49 with a standard deviation of 13.68. Thus, the mean more than doubled between pretest and posttest, with standard deviation remaining

Table 3. Pretest knowledge scores for students in this study

Score	Frequency	Percent	Mean	Standard Deviation
0	1	1.0		
5	8	7.8		
10	9	8.7		
15	10	9.7		
20	13	12.6		
25	19	18.4		
30	16	15.5		
35	10	9.7		
40	8	7.8		
45	5	4.9		
55	1	1.0		
65	2	1.9		
80	1	1.0		
Total	103	100.0	25.78	13.81

Table 4. Posttest knowledge scores for students in this study

Score	Frequency	Percent	Mean	Standard Deviation
10	1	1.0		
35	5	4.9		
40	12	11.7		
45	11	10.7		
50	13	12.6		
55	18	17.5		
60	15	14.6		
65	16	15.5		
70	1	1.0		
75	3	2.9		
80	4	3.9		
85	2	1.9		
90	1	1.0		
100	1	1.0		
Total	103	100.0	55.49	13.68

about the same. Figures 1 and 2 reveal that the pretest and posttest scores resembled a normal distribution.

Pretest and Posttest Attitude Inventory

The attitude inventory was composed of 18 statements designed to obtain information concerning student attitudes toward computers and computer use. A copy of the instrument can be found in Appendix C. A semantic differential scale was used with five sets of bipolar adjectives for each statement. It was administered as pretest and posttest

```
Frequency    Score
    1          .00 |***
    8         5.00 |******************
    9        10.00 |*********************
   10        15.00 |*************************
   13        20.00 |***********************************
   19        25.00 |*************************************************
   16        30.00 |******************************************
   10        35.00 |*************************
    8        40.00 |*******************
    5        45.00 |************
    0        50.00 |
    1        55.00 |***
    0        60.00 |
    2        65.00 |*****
    0        70.00 |
    0        75.00 |
    1        80.00 |***
                   |_____________________________________________________
                   0        4         8         12        16        20
                                  Histogram Frequency
```

Figure 1. Pretest knowledge score

Frequency	Score	
1	10.00	**
0	15.00	
0	20.00	
0	25.00	
0	30.00	
5	35.00	*************
12	40.00	*******************************
11	45.00	****************************
13	50.00	************************************
18	55.00	***
15	60.00	**************************************
16	65.00	**
1	70.00	**
3	75.00	*********
4	80.00	***********
2	85.00	***
1	90.00	**
0	95.00	
1	100.00	***

0 4 8 12 16 20

Histogram Frequency

Figure 2. Postest knowledge score

requiring approximately ten minutes to complete. The researcher determined a weighted mean for each question with equal weights for all questions and a composite score was determined for both pretest and posttest instruments for each student.

As Table 5 indicates, the mean score for the pretest attitude inventory was 100.15, with a standard deviation of 10.72. Table 5 also shows a mean posttest attitude score of 99.74, with a standard deviation of 11.24. As shown in Figure 3 and 4, each resembled a normal distribution. The slightly lower posttest attitude score can be explained by a change in student expectations. Students coming into the class for the first time frequently have ultra high expectations of what the microcomputer can do. After being in class for a few weeks, they begin to realize how much work is involved in microcomputer programming, since the microcomputer is totally dependent upon the programmer for instructions. Student attitude and interest then starts to diminish.

Table 5. Pretest and posttest attitude inventory

	Score	Frequency	Percent	Mean	S.D.
Pretest	75	4	3.0		
	85	8	7.8		
	90	17	16.5		
	95	8	7.8		
	100	22	21.4		
	105	15	14.6		
	110	17	16.5		
	115	9	8.7		
	120	2	1.9		
	125	1	1.0		
Total		103	100.0	100.15	10.72
Posttest	58	1	1.0		
	70	1	1.0		
	80	2	1.9		
	85	11	10.7		
	90	10	9.7		
	95	17	16.5		
	100	17	16.5		
	105	19	18.4		
	110	12	11.7		
	115	9	8.7		
	120	3	2.9		
	125	1	1.0		
Total		103	100.0	99.74	11.24

```
Frequency   Score
    4        75.00 |********
    0        80.00 |
    8        85.00 |***************
   17        90.00 |***********************************
    8        95.00 |****************
   22       100.00 |**********************************************
   15       105.00 |*******************************
   17       110.00 |***********************************
    9       115.00 |******************
    2       120.00 |****
    1       125.00 |**
                    ___________________________________________________
                   0        5         10        15        20        25

                              Histogram Frequency
```

Figure 3. Pretest attitude score

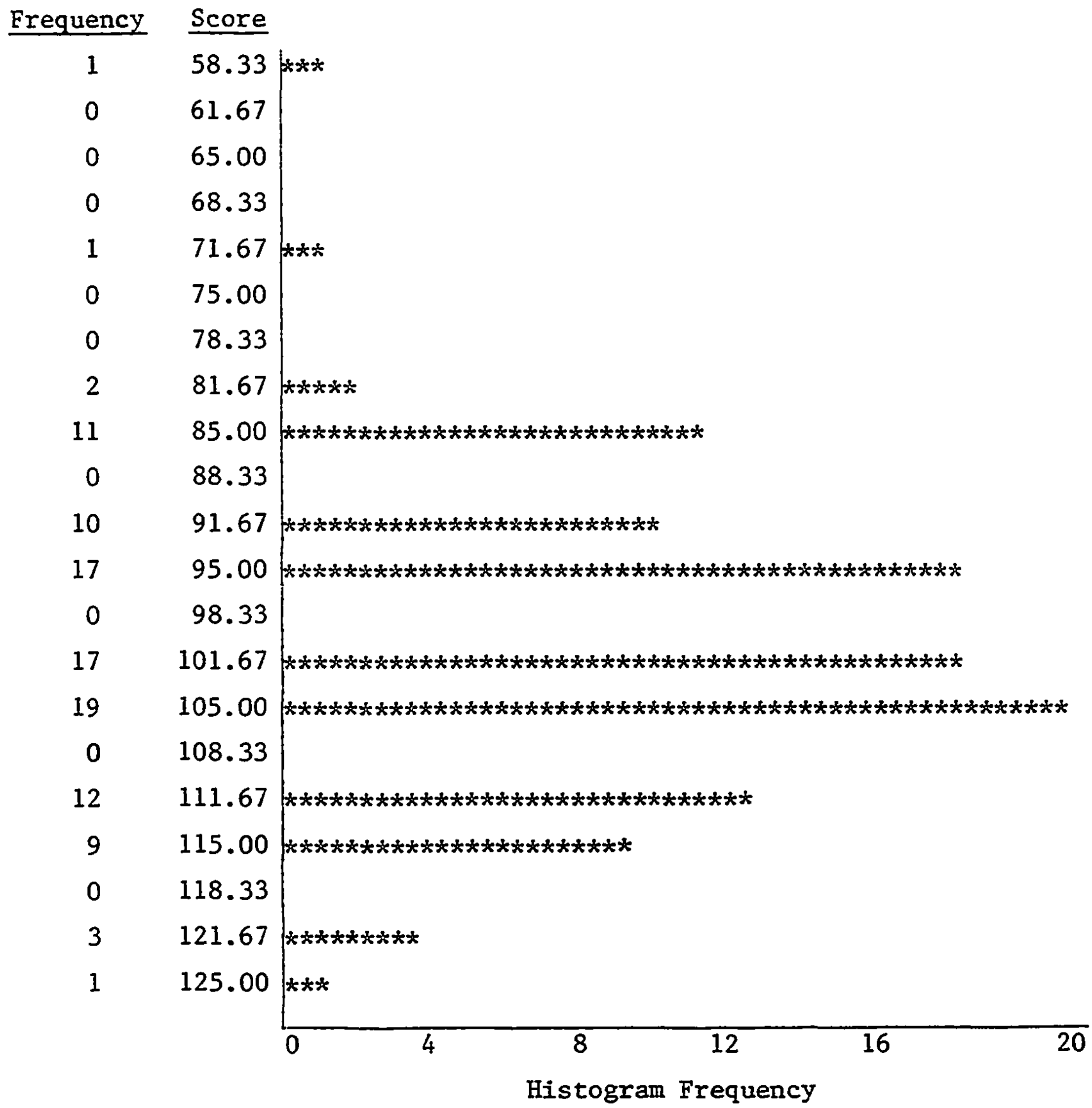

Figure 4. Posttest attitude score

Instrument Reliability

Cronbach's Coefficient Alpha was used to determine internal consistency of the knowledge test and attitude inventory by performing an item analysis on the individual test questions for each instrument. As shown in Table 6, the overall reliability coefficient for the attitude inventory was 0.90, and the reliability coefficient for the knowledge test was 0.81. Also shown in Table 6 are the mean, standard deviation and reliability coefficient for each instrument for Fall and Spring semesters.

Table 6. Reliability coefficients, means, and standard deviations for the knowledge test and attitude inventory

	Alpha	Standardized Item Alpha	Mean	Standard Deviation
Knowledge test				
Fall	0.84	0.83	8.02	4.18
Spring	0.79	0.79	8.12	3.78
Attitude inventory				
Fall	0.90	0.91	97.28	11.39
Spring	0.89	0.91	98.22	11.08
Knowledge test				
Combined	0.81	0.81	8.08	3.94
Attitude inventory				
Combined	0.90	0.91	97.83	11.19

The Effect of Teaching Method or Demographic Characteristics on Knowledge Posttest Scores

An analysis of covariance was used to determine if students' posttest knowledge scores were significantly affected by the teaching method or the demographic characteristics. The pretest knowledge score was used as the covariate in both cases. No significant difference was found between students' knowledge scores when grouped by the teaching method. The F statistic and F probability for this test are shown in Table 7.

Table 7. F-values and F probability for posttest knowledge scores (achievement) with pretest knowledge score and teaching method

	F Statistics	F Probability
Teaching method	0.34	0.56

This would indicate that the computer-assisted instructional materials are as effective as, but not superior to, the conventional lecture method of teaching BASIC programming. Although not significantly different, the mean posttest knowledge score for the experimental group (55.93) was slightly higher than the mean posttest knowledge score for the control group (55.17).

A total of 28 student demographic characteristics (independent variables) were analyzed individually with the analysis of covariance model to determine their effect on the students' knowledge scores. The pretest knowledge score was used as the covariate. Degrees of freedom were determined by the groups rather than the number of students. Table 8 shows the F statistics and F probability for each of the 28 demographic characteristics for achievement. Table 9 contains the frequencies and cell means of the posttest knowledge score for those demographic characteristics that were significant at the 0.10 level ($P<.10$).

There was a significant difference in posttest knowledge scores when comparing the semesters of vocational agriculture (variable Question 2). Table 9 shows that those students with no vocational agriculture scored significantly higher than the other two categories. It is highly likely that those students who scored higher enrolled in other courses, such as mathematics or science, or did not enroll in vocational agriculture because it was not offered.

A significant difference was also found between students' knowledge scores when grouped by subjects in which the students earned their highest and lowest grades in grades 9 through 12. Table 8 indicates an F probability value of .10 for variable Question 3 when the students were grouped according to the subject in which they earned their highest grade. As shown in Table 9, the posttest knowledge score means were higher for students enrolled in mathematics, English, or physical education. The lowest grades were made in history or industrial arts. When grouped by the subject in which students earned their lowest grade (variable Question 4), an F probability value of .001 was found. Variable Question 4 shows that the students who earned their lowest grades in mathematics tended to have the lowest posttest knowledge scores.

Table 8. F-values and F probability for posttest knowledge scores (achievement) with pretest knowledge score and student characteristics

Independent Variable	Variable Description	F Value	F Probability
Question 1	Setting where you were raised	0.80	0.45
Question 2	Semesters of vo-ag in grades 9-12	3.00*	0.06
Question 3	Subject of highest grade in grades 9-12	1.85*	0.10
Question 4	Subject of lowest grade in grades 9-12	4.29**	0.001
Question 5	Best liked subject in grades 9-12	1.43	0.21
Question 6	Least liked subject in grades 9-12	1.35	0.25
Question 7	Semesters of math in grades 9-12	1.38	0.22
Question 8	Average math grade in grades 9-12	3.49**	0.02
Question 9	Words typed per minute	1.56	0.16
Question 10	Father or male guardian occupational computer use	0.00	0.97
Question 11	Mother or female guardian occupational computer use	0.24	0.63
Question 12	Student classification	3.04**	0.02
Question 13	Student major	1.86*	0.08
Question 14	Computer experience	1.61	0.19
Question 15	Microcomputer instruction	1.86	0.18
Question 16	Mainframe-computer instruction	0.01	0.91
Question 17	Microcomputer ownership	1.35	0.25
Question 18	Parent or guardian computer ownership	0.20	0.65
Question 19	Basic calculator experience	1.50	0.20

*Significant at the .10 level (P<.10).
**Significant at the .05 level (P<.05).

Table 8. (Continued)

Independent Variable	Variable Description	F Value	F Probability
Question 20	Programmable calculator experience	0.73	0.40
Question 21	Post-secondary semesters of math	1.56	0.17
Question 22	Post-secondary average math grade	2.36*	0.08
Question 23	Video game experience	3.68**	0.02
Question 24	Computer interest from employment	0.98	0.33
Question 25	Occupational plans	2.35**	0.02
Question 26	Factor influencing you to take course	1.34	0.25
Question 27	Person influencing you to take course	3.53**	0.03
Question 28	Command of English language	1.44	0.23

Variable question 5 and Question 6 were not significant. This indicates that subjects liked or disliked had no significant influence on posttest scores. Likewise, the semesters of mathematics at the secondary level was not significant as noted by variable Question 7. Similarly, the semesters of mathematics at the post-secondary level (variable Question 21) were not significant.

While the number of semesters of mathematics was not significant, the average mathematics grade at the secondary or post-secondary was significant. Variable Question 8, average mathematics grade in grades 9 through 12, and variable Question 22, average mathematics grade at the post-secondary level, were both significant as noted in Table 8. Table 9 shows that as average mathematics grades increased from "D" to "A", posttest knowledge scores increases sharply. In fact, students who earned an "A" grade in mathematics at the secondary level scored almost 20 points higher than those students who earned a "D" grade and almost 10 points higher than those students earning a "C" grade.

No significant difference was found in knowledge scores when the students were grouped according to either typing speed (variable Question 9), or the students' male or female guardian occupational computer use (variables Question 10 and Question 11).

When grouped by student classification or student major, a significant difference was found. An analysis of covariance revealed an F probability of 0.02 (Table 8) when grouped by the students' present classification (variable Question 12), and an F probability of 0.08 when grouped by the students' major (variable Question 13). Table 9 shows that the "sophomores" and "juniors" scored higher than "freshmen" or "seniors." Likewise, students majoring in forestry, horticulture, and non-agricultural disciplines scored the highest on the knowledge posttest. It is also interesting to note that students majoring in agricultural mechanization, farm operations, agricultural business, and agronomy scored higher than students in dairy science and fish and wildlife.

No significant difference (Table 8) was found in knowledge scores when the students were grouped by computer experience (variable Question

14), formal microcomputer instruction (variable Question 15), formal mainframe-computer instruction (variable Question 16), microcomputer ownership (variable Question 17), parent or guardian computer ownership (variable Question 18), years of basic calculator experience (variable Question 19), or years of programmable calculator experience (variable Question 20).

The analysis of covariance did, however, reveal a significant difference in knowledge test scores when the students were grouped by hours of video game experience, occupational plans, or who influenced the student to enroll in the course. Table 8 shows an F probability of 0.02 when the students were grouped by hours of video game experience (variable Question 23), 0.02 when grouped by occupational plans (variable Question 25), and 0.03 when grouped according to the person that most influenced the student to take the course (variable Question 27). The cell means for these variables are shown in Table 9. No definite trends can be established from the cell means.

When grouped by whether or not the student had had employment experience that attributed to their interest in computers (variable Question 24), the factor that most influenced them to take the course (variable Question 27), or command of the English language (variable Question 28), no significant difference was found in knowledge scores (Table 8).

Table 9. Frequencies and cell means of demographic characteristics for posttest knowledge scores significant at P<.10

Independent Variable	Variable Description	Frequency	Posttest Knowledge Score Mean
Question 2	Semesters of Vocational Agriculture Grades 9-12		
	0	52	59.04
	1-3 years	16	47.50
	4 or more years	35	53.86
Question 3	Highest Grade Subject Grades 9-12		
	Math	25	59.00
	Science	21	54.76
	History	8	45.63
	English	9	61.11
	Physical Education	6	64.17
	Vocational Agriculture	21	55.24
	Industrial Arts	13	48.46
Question 4	Lowest Grade Subject Grades 9-12		
	Math	29	49.66
	Science	11	53.64
	History	23	56.09
	English	29	58.62
	Physical Education	3	73.33
	Industrial Arts	1	100.00
	Other	5	53.00
Question 8	Average Math Grade Grades 9-12		
	D	2	42.50
	C	27	52.78
	B	46	53.91
	A	28	61.61

Question 12	Student Classification		
	Freshman	2	45.00
	Sophomore	9	57.78
	Junior	26	57.12
	Senior	63	53.81
	Other	3	76.67
Question 13	Student Major		
	Ag Mechanics	5	59.00
	Fish and Wildlife	8	43.75
	Farm Operations	34	57.35
	Horticulture	7	62.86
	Dairy Science	11	50.45
	Ag Business	27	54.44
	Agronomy	6	55.00
	Forestry	2	72.50
	Non-Agriculture	3	60.00
Question 22	Post-Secondary Average Math Grade		
	D	3	55.00
	C	42	51.67
	B	35	55.86
	A	21	61.19
Question 23	Hours on Video Games		
	0	15	62.33
	1-10	48	55.94
	11-50	23	49.13
	More than 50	14	55.71

Table 9. (Continued)

Independent Variable	Variable Description	Frequency	Posttest Knowledge Score Mean
Question 25	Occupational Plans		
	Farming	40	55.13
	Farm Management	9	59.44
	Ag Mechanics	2	70.00
	Ag Sales and Service	8	51.25
	Ag or Extension Education	3	75.00
	Ag Business	19	55.53
	Forestry	1	80.00
	Fish and Wildlife	9	46.11
	Administration	2	72.50
	Other	9	49.44
Question 27	Person influencing you to take course		
	Myself	71	58.10
	Advisor	23	47.83
	Others	6	51.67

The Effect of Teaching Method or Demographic Characteristics on Attitude Posttest Scores

To determine if student posttest attitude scores are significantly affected by teaching method, an analysis of covariance was used with pretest attitude scores as the covariate. Table 10 indicates that there was no significant difference between students grouped according to teaching method and posttest attitude scores. Therefore, attitude was not affected by the teaching method. Though not significant, there was a difference between the two groups, with the posttest attitude score mean of the control group (99.97) being slightly higher than the posttest attitude score mean for the experimental group (99.40).

Table 10. F-values and F probability for posttest attitude scores with pretest attitude scores and teaching method

Teaching method	F Statistics	F Probability
	0.17	0.68

The same 28 demographic characteristics of the students were analyzed individually with an analysis of covariance model to determine their effect on the students' attitude scores. The posttest attitude score was compared to each individual demographic characteristic with the teaching method and the pretest attitude score as the covariate. Degrees of freedom were determined by the experimental units rather than the number of students.

Table 11 shows the F statistic and F probability for each of the 28 demographic characteristics for attitude scores. The only independent variables showing a significant difference in posttest attitude score means were typing ability (variable Question 9) and computer experience (variable Question 14). An analysis of covariance revealed a significant difference between attitude scores when the students were grouped by the number of words typed per minute (Table 11).

As shown in Table 12, those students typing at least 11 words per minute scored better on the attitude posttest. A significant difference was found between attitude scores when the students were grouped by computer experience. Computer experience was closely related to attitude posttest score. As computer experience increased, the posttest attitude score increased. In fact, those students with no computer experience scored nearly 30 points less than those students with "much" computer experience.

Table 11. F-values and F probability for posttest attitude scores with pretest attitude scores and student characteristics

Independent Variable	Variable Description	F Value	F Probability
Question 1	Setting where you were raised	2.05	0.13
Question 2	Semesters of vo-ag in grades 9-12	0.64	0.53
Question 3	Subject of highest grade in grades 9-12	0.72	0.63
Question 4	Subject of lowest grade in grades 9-12	1.21	0.31
Question 5	Best liked subject in grades 9-12	0.59	0.76
Question 6	Least liked subject in grades 9-12	0.99	0.43
Question 7	Semesters of math in grades 9-12	0.83	0.58
Question 8	Average math grade in grades 9-12	0.69	0.56
Question 9	Words typed per minute	2.42**	0.03
Question 10	Father or male guardian occupational computer use	0.52	0.47
Question 11	Mother or female guardian occupational computer use	0.00	0.96
Question 12	Student classification	1.39	0.25
Question 13	Student major	1.52	0.16
Question 14	Computer experience	3.03**	0.03
Question 15	Microcomputer instruction	0.30	0.58
Question 16	Mainframe-computer instruction	0.01	0.91
Question 17	Microcomputer ownership	0.00	0.95
Question 18	Parent or guardian computer ownership	0.54	0.47
Question 19	Basic calculator experience	1.34	0.26
Question 20	Programmable calculator experience	0.79	0.38

**Significant at the P<.05 level.

Table 11. (Continued)

Independent Variable	Variable Description	F Value	F Probability
Question 21	Post-secondary semesters of math	1.71	0.13
Question 22	Post-secondary average math grade	0.48	0.70
Question 23	Video game experience	1.37	0.26
Question 24	Computer interest from employment	0.09	0.76
Question 25	Occupational plans	0.77	0.64
Question 26	Factor influencing you to take course	1.38	0.24
Question 27	Person influencing you to take course	0.81	0.45
Question 28	Command of English language	1.03	0.40

Table 12. Frequencies and cell means of demographic characteristices for posttest attitude scores

Variable Independent		Frequency	Posttest Knowledge Score Mean
Question 9	Typed Words Per Minute		
	0	13	96.92
	1-10	10	88.30
	11-20	23	102.61
	21-30	19	104.21
	31-40	22	98.41
	41-50	10	97.50
	51-60	5	111.00
	61-70	1	95.00
Question 14	Computer Experience		
	None	26	96.92
	Little	49	99.35
	Some	25	100.80
	Much	3	121.67

The Effect of Pretest Attitude Scores on Posttest Knowledge Scores

Analysis of covariance was used to determine if students posttest knowledge scores were significantly affected by attitude. The pretest knowledge score was used as the covariate. The analysis revealed a significant difference between students grouped according to their pretest attitude scores and posttest knowledge scores as shown in Table 13.

Table 13. F-values and F probability for posttest knowledge scores (achievement) with pretest knowledge scores and attitude

	F Statistics	F Probability
Achievement attitude	1.84*	0.07

*Significant at the $P<.10$ level.

There was a definite positive relationship between pretest attitude score and posttest knowledge score (Figure 5). As the pretest attitude score increased, the posttest knowledge score increased. In fact, there was a 50 percent increase in posttest knowledge score as the pretest attitude score increased from 71-85 to 116-125 (Table 14).

Table 14. Frequencies and cell means of the posttest knowledge scores for the pretest attitude scores

Independent Variable	Category	Frequency	Posttest Knowledge Score Mean
Pretest attitude	71-75	4	47.50
	81-85	8	49.38
	86-90	17	51.47
	91-95	8	56.88
	96-100	22	51.19
	101-105	15	60.67
	106-110	17	61.18
	111-115	9	55.56
	116-120	2	77.50
	121-125	1	80.00

Summary

In summary, the factors that significantly affected achievement were attitude, semesters of vocational agriculture, the subject in which the students made their highest and lowest grade, average secondary and post-secondary mathematics grade, student classification, student major, video game experience, occupational plans, and the person that most influenced the student to take the course. The factors that significantly affected attitude were typing ability and computer experience.

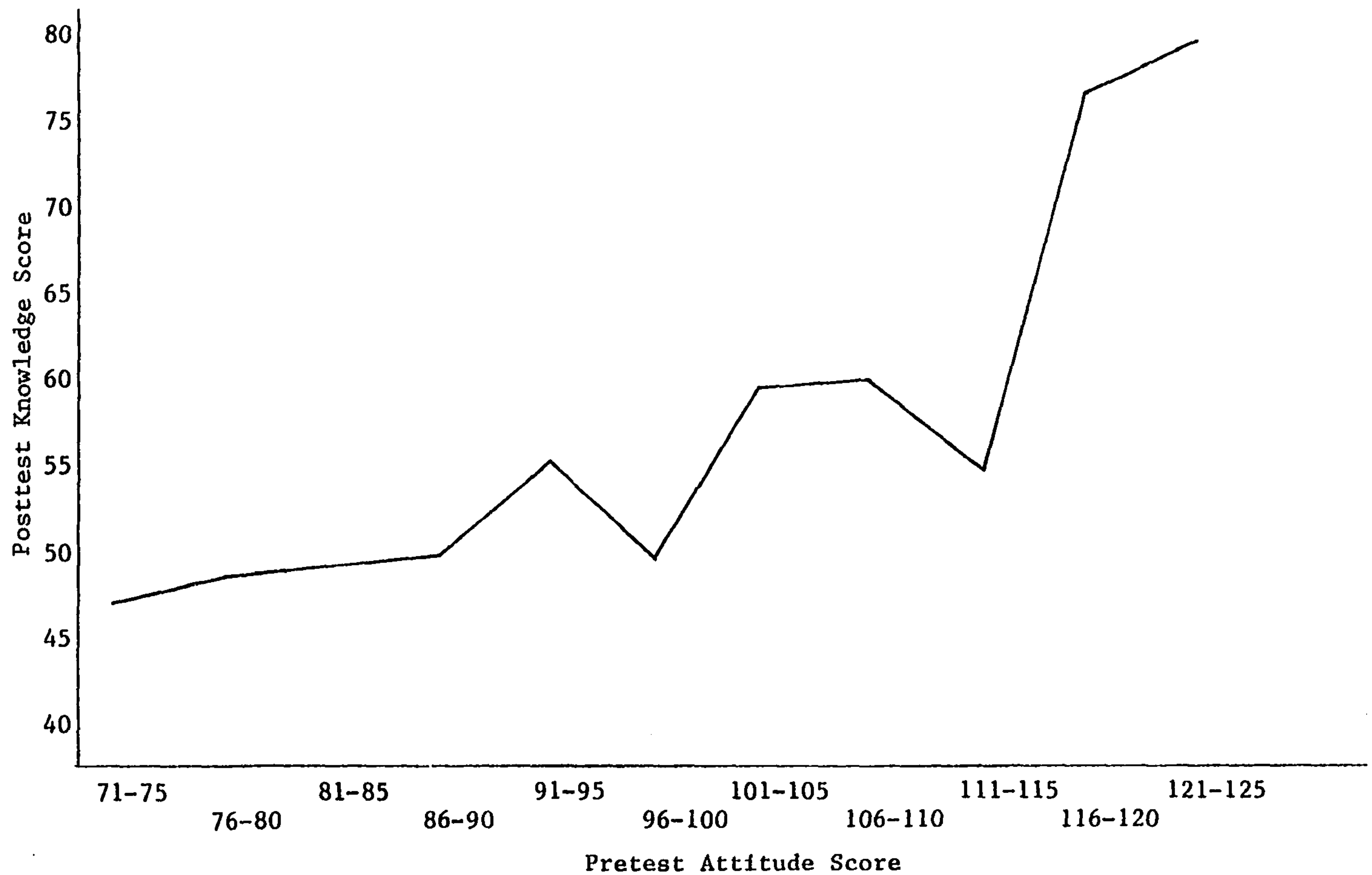

Figure 5. Data plots of posttest knowledge scores with pretest attitude scores

CHAPTER V.

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

This study was undertaken to analyze selected factors that affect attitude or achievement in a BASIC computer programming class in the Agricultural Engineering Department, Iowa State University. This research topic was selected because of a lack of related research in the literature. The specific objectives of the study were to determine if a significant difference exists (1) between student knowledge scores when the students are grouped by teaching method, pretest attitude scores, or demographic characteristics, and (2) between student attitude scores when the students are grouped by teaching method or demographic characteristics. The teaching methods that were used were computer-assisted instruction (computer programs developed by the researcher) and traditional lecture instruction.

Three instruments were developed for the study. The demographic survey collected data on students' background, academic training and achievement, computer experience, and occupational plans. The knowledge test was administered as a pretest and posttest to determine the students' knowledge of BASIC computer programming and computer use. The attitude inventory was also administered as a pretest and posttest and was designed to measure the students' attitude toward computer programming and computer use. All instruments were pilot-tested and revised accordingly.

The population for this study consisted of the students in the College of Agriculture at Iowa State University. The sample consisted of the students enrolled in the Agricultural Mechanization 180X course for the Fall, 1983 and Spring, 1984 semesters. Classes were randomly selected as experimental and control groups and were randomly assigned to the two instructors involved. An Analysis of Covariance was used to analyze the data, and Cronbach's Alpha Coefficient was used to measure reliability.

Summary and Conclusions

On the basis of the statistical analysis, the following statements summarize the major findings of this study.

1. The major characteristics of the students who participated in the study were:
   a. seventy-six percent were raised on the farm, 14 percent in a rural setting, and 13 percent in the city.
   b. almost 90 percent were classified as juniors or seniors,
   c. over 60 percent were majoring in either farm operations or agricultural business, and
   d. almost 40 percent planned to return to farming after graduation, and the majority of the rest planned to enter an agricultural business.
2. The major academic characteristics of the students who participated in the study were:

a. mean years of vocational agriculture at the secondary level was .84 years,

b. mean semesters of mathematics at the secondary level was 5.64 semesters,

c. mean post-secondary semesters of mathematics was 2.46,

d. mean average mathematics grade at the secondary level was 2.97 with 2 being a "C" and 3 being a "B",

e. mean post-secondary average mathematics grade was 3.73 with 3 equaling a "C" and 4 equaling a "B",

f. highest grade subjects at the secondary level were mathematics, science, and vocational agriculture,

g. lowest grade subjects at the secondary level were mathematics, history, and English,

h. best liked subjects at the secondary level were science and vocational agriculture,

i. least liked subjects at the secondary level were mathematics, English, and history, and

j. mean typing ability was 2.78 with 2 equaling 11 to 20 words per minute and 3 equaling 21 to 30 words per minute.

3. The major computer-related characteristics of the students who participated in this study were:

   a. over 70 percent had computer experience,

   b. over 70 percent had no mainframe or microcomputer formal instruction,

c. less than two percent owned a computer,

d. less than eight percent of the students' parents owned a computer,

e. mean years basic calculator experience was 7.26 years,

f. mean years programmable calculator experience was 0.24 years, and

g. mean hours on video games was 1.36 with one equaling one to ten hours and two equaling 11 to 50 hours. Almost 14 percent of the students had more than 50 hours of experience playing video games.

4. An analysis of covariance failed to reveal a significant difference in either posttest attitude scores or posttest knowledge scores when the students were grouped by teaching method (computer-assisted instruction versus traditional lecture). This suggests that computer-assisted instruction is neither superior nor inferior as a teaching method to traditional lecture. In the literature, whether or not computer-assisted instruction produces superior results compared to traditional lecture is dependent on the subject matter being taught. Russell (1984) found that computer-assisted instruction produced both equal achievement and superior achievement, depending on what is being taught. Rice (1973) found no difference in achievement when teaching mathematics concepts between the two teaching methods. Kockler and Netusil (1974)

found that teaching with computer-assisted instruction significantly improves attitude toward computer-assisted instruction compared to traditional lecture. They failed to find, however, a significant difference between the two teaching methods when grouped by attitudes toward mathematics or achievement in mathematics. The remainder of the literature is, comparatively, inconclusive. The success of computer-assisted instruction as a superior teaching method appears to be dependent upon the subject matter being taught. It does, however, appear to be at least equal to the traditional lecture method in almost all cases. Computer-assisted instruction gives the instructor more time in class for individualized instruction and other classroom activities. The disadvantage is that it requires a great deal of time for the initial preparation of the computer-assisted instruction material.

5. When the students were grouped by their pretest attitude scores, a significant difference was found in achievement scores. Using an analysis of covariance, the posttest knowledge scores were significantly higher for students with a higher pretest attitude score compared to the students with a lower pretest attitude score. While there is no literature available for comparison, the results indicate that student attitude entering a class may be a barrier to achievement.

However, the intimidation or fear of the computer that the student has appears to take longer than the duration of this experiment to dissipate. While not statistically proven, by the end of the semester relatively all students have lost the fear or intimidation of the computer, and according to grades, the difference between the two groups in achievement appears to disappear. So, while the initial attitude makes a difference in achievement in a short period of time, it may not make much difference over an increased period of time.

6. An analysis of covariance revealed significant differences in posttest knowledge scores when the students were grouped by selected demographic characteristics. There are few studies in the literature for comparison.

   When grouped by years of vocational agriculture, a significant difference was found in knowledge scores. Students with no vocational agriculture scored significantly higher than students with vocational agriculture. Two possible explanations exist. Instead of taking vocational agriculture, these students enrolled in courses that affected their level of achievement. Also, some secondary schools may not have offered vocational agriculture.

   Grouping the students by subjects in which they earned their highest grades at the secondary level showed a significant difference in knowledge scores. The students that made their highest grades in physical education, English, and mathematics also made the highest posttest knowledge scores in this study. This complements a study by Friesen (1976) who also found that students with good prior achievement in mathematics achieved the best in a university mathematics course. It should be pointed out that the sample size was very small for the English category (9 observations) and for the physical education category (6 observations); hence, any generalization of this finding is very limited.

When grouped by subjects in which the students made their lowest grades at the secondary level, a significant difference was found in knowledge scores. Students earning their lowest grades in mathematics, science, and history scored lower on the achievement test than students who made their lowest grades in English, physical education, and industrial arts. This complements the previous finding concerning mathematics and substantiates the conclusion that the generalization of English and physical education as a predictor of achievement in computer skills is very limited.

When grouped by average mathematics grade at the secondary level or average mathematics grade at the post-secondary level, a significant difference was found in knowledge scores. As the average mathematics grade rose from "D" to "A", the knowledge scores rose almost correspondingly. Again, this substantiates the results found in the literature and those findings previously discussed. Evidentally, the ability to achieve in mathematics is the same type of ability required to achieve in computer skills and programming. It should be noted that the amount of mathematics in secondary or post-secondary schools produced no significant differences, only the grade earned made a difference.

A significant difference was found in knowledge scores when grouping the students by student classification. The posttest knowledge score mean for sophomores, juniors, and seniors was significantly higher than for freshmen; however, the posttest knowledge score mean for other students (graduates and special) was significantly higher than the sophomore, junior, or senior group. Due to the small sample size in the "other" and "freshman" categories, generalization of this finding is very limited, especially since there was such a small difference in knowledge scores among the sophomore, junior, and senior groups.

Students' major had a significant influence on knowledge scores. The posttest knowledge score mean for the forestry, horticulture, and non-production agriculture group was higher than for the other groups while the means for the agricultural mechanization, farm operations, agricultural business, and agronomy students were higher than the means for the dairy science and fish and wildlife groups. No plausible explanation exists for these differences.

When grouped by the hours of video game experience, there was a significant difference in knowledge scores. The group that had no video game experience had the highest means for the posttest knowledge scores. This information would, no doubt, be upsetting to the manufacturers of video games and equipment, but again, no plausible explanation exists for the differences.

Grouping by occupational plans showed a significant difference in knowledge scores. The occupational groups with the highest means were forestry, agricultural or extension education, administration, and agricultural sales and service groups had higher posttest knowledge score means than the fish and wildlife, or other categories.

When grouped by the person that most influenced the student to take the course, a significant difference was found in knowledge scores. The "myself" category had a higher mean than the other two categories, and the "advisor" category had the lowest mean. It is apparent that student desire is a better motivator to achieve in a BASIC programming class. Most students (as indicated by the large sample size in the "myself" category) indicated that they enrolled in order to learn how to use a computer. Often times, the course was taken even though it was not part of their program of study. Wanting to be enrolled in the class rather than having to be there evidentally makes a difference.

7. An analysis of covariance revealed significant differences in posttest attitude scores when the students were grouped by selected demographic characteristics. There are few studies in the literature to substantiate these conclusions.

   When grouped by typing ability, a significant difference was found in attitude scores. Generally, the students that could type more than ten words per minute had higher posttest attitude scores than those that could not. Because actual programming does not begin until after the basic commands are learned (6 to 7 weeks into the semester), the students' typing ability is not really important during the first weeks. Though not statistically proven, it is possible that the difference in attitude due to typing ability increased more dramatically after the time allotted for this research than it did during the research.

   Grouping students by computer experience revealed a significant difference in attitude scores. As the amount of computer experience increased, the posttest attitude score increased correspondingly. This can be explained by the fact that as a student's computer use increases, the fear or intimidation of it dissipates. As the student begins to feel more in control of the computer, the attitudes will eventually become more positive.

Implications

Implications of the findings of this research include the following:

1. Since ability in mathematics appears to be one of the prime indicators of achievement in computer skills, and since agriculture is very involved and will become more involved in the future with the computer as a management tool, vocational agriculture and agricultural/agribusiness education should place more emphasis on mathematics-oriented skills in all phases of the disciplines.
2. Programs of vocational agriculture and agricultural/agribusiness education should introduce their students to the rigors of computer skills as early as possible within the program to help them overcome the fear and intimidation of the computer, and to improve their attitude toward the computer and computer use.
3. Students of agriculture need to develop typing skills in order to use the computer efficiently.
4. Advisors, teachers, parents, and other influencing individuals need to impress upon agricultural students the advantage of possessing computer skills in order to motivate the student to take computer classes rather than having the student take the class to fill a program of study.
5. Teachers in the discipline of agriculture need to adopt the computer as a teaching aid and develop or procure the software

to meet their needs. The computer will not take the place of the teacher, but will supplement and enhance the lesson material, allowing the teacher more time for individualized instruction and other classroom activities.

6. In order for students to maximize their potential, prerequisite mathematics courses and specific levels of mathematics achievement should be required of students that wish to enroll in post-secondary computer classes.
7. Because computer-assisted instruction has been proven to be at least as effective a teaching method as conventional lecture, course structure can be changed to accomodate the new teaching aid, thereby giving the teacher more time for individualized instruction and other classroom activities.
8. The use of computer-assisted instruction in the classroom will increase the time a teacher has to practice the pragmatic approach to teaching by increasing individualized instruction.

Recommendations for Further Study

The findings of this study should complement and enhance research already conducted in the area of computer-assisted instruction, and should provide information to teachers of agricultural/agribusiness education on factors to consider when making decisions concerning computer-related instruction. Based on the findings of this study, the following areas are recommended for further study:

1. Further research is warranted that would encompass the objectives of this study for similar subject matter, but over a longer period of time.
2. Further research should be conducted to determine how demographic and other factors affect attitude or achievement in other areas of study within agriculture.
3. Studies should be conducted to determine how computers can best be utilized within the discipline of agriculture at the secondary and post-secondary levels.
4. Studies should be conducted to determine what types and specific software packages teachers of agriculture need in order to prepare their students for employment.
5. Research should be conducted to identify relationships between student demographic characteristics, attitudes, achievement, and other factors relative to the development of computer skills and expertise.
6. Research should be conducted to identify factors that affect student achievement or attitudes in courses that teach other programming languages.
7. Studies should be conducted that focus on the relationship of prior student academic achievement to attitudes or achievement in computer applications or computer programming.
8. Studies should be conducted to determine what type of

mathematics courses have the greatest effect on student attitudes or achievement in computer programming courses.

9. Research should be conducted to identify methods of improving utilization of teacher resources in the classroom while using computer-assisted instruction.

REFERENCES

Allen, Michael Wakefield. 1971. The prediction of achievement in computer assisted instruction versus lecture instruction using linear multiple regression techniques. Ph.D. Dissertation. Library, The Ohio State University, Columbus, Ohio.

American Heritage Dictionary of the English Language, The. 1980. Houghton Mifflin Company, Boston, Massachusetts.

Beane, Daniel C. 1969. Experimental evaluation of student achievement in vocational agriculture based on instructor knowledge and media used. M.S. Thesis. Library, Iowa State University, Ames, Iowa.

Borg, Walter R. and Meredith D. Gall. 1983. Educational Research: An Introduction. Fourth Edition. Longman, Inc., New York, New York.

Bradford, Mark W. 1984. Buyer Beware When you Choose a Computer. Farm Journal

Broh, C. Anthony. 1975. Achievement and attitude with computer related instruction: A field experiment. Paper presented at the Annual Meeting of the American Political Science Association, San Francisco, California.

Bunch, John M. 1983. Planning for Computers. VocEd Journal of the American Vocational Association 58(5): 46.

Conklin, D. N. 1983. A Study of Computer-Assisted Instruction in Nursing Education. Journal of Computer-Based Instruction 9(3): 98-107.

Dobbins, Craig L. and Robert C. Suter. 1982. A Microcomputer for the Farm Family? Department of Agricultural Economics. Indiana Cooperative Extension Service, Purdue University EC-527: 19.

Elbert, David. 1984. Poll: A Third of Iowans Join Computer Age. Des Moines Sunday Register (Des Moines, Iowa) Sec. A, p. 1 and 4.

Fiske, Edward. 1983. Computer Education: Update '83. Popular Computing 3(7): 86-147.

Foster, Rick. 1982. Computers in Agriculture. Agricultural Education Magazine 54(7): 5-6.

Friesen, Vernon Eugene. 1976. The relationship of affective and cognitive variables to achievement and attitude under lecture-discussion and computer-assisted instruction. Ph.D. Dissertation. Library, Kansas State University, Manhattan, Kansas.

Gille, George L. 1982. When to Find Computer Programs in the Midwest. Agricultural Education Magazine 54(7): 17.

Hinkle, Dennis E., William Wiersma, and Stephen S. Jurs. 1979. Applied Statistics for the Behavioral Sciences. Rand McNally College Publishing Company, Chicago, Illinois.

Johnson, Stephen. 1983. Microcomputer as a decision-making aid in teaching farm management. M.S. Thesis. Library, Iowa State University, Ames, Iowa.

Kockler, Lois H. and Anton J. Netusil. 1974. CAI: Overcoming Attitude Barriers.

Leedy, Paul D. 1980. Practical Research-Planning and Design. Second Edition. Macmillan Publishing Col., Inc., New York, New York.

Legacy, James, Tom Stitt, and Fred Reneau. 1984. Microcomputing in Agriculture. Reston Publishing Company, Inc., A Prentice-Hall Company, Reston, Virginia.

Leising, James G. 1982. Are You Ready for Computers in Agriculture? Agricultural Education Magazine 54(7): 4.

Osgood, Charles E. 1971. The Measurement of Meaning. University of Illinois Press, Chicago, Illinois.

Pournelle, Jerry. 1984. The Management Revolution. Popular Computing 3(7): 81-86.

Rice, Billie Ann Perrin. 1973. A Comparison of Computer-Assisted Instruction, Programmed Instruction, and Lecture in Teaching Fundamental Concepts of Calculus. Georgia State University, Atlanta, Georgia.

Rota, Danie Regis. 1981. Computer-Assisted Instruction, Lecture Instruction, and Combined Computer-Assisted/Lecture Instruction: A Comparative Experiment. University of Pittsburgh, Pittsburgh, Pennsylvania.

Rushinek, Avi, Sara F. Rushinek, and Joel Stutz. 1981. The Effects of Computer Assisted Instruction Upon Computer Facility and Instructor Ratings. Journal of Computer-Based Instruction 8(2): 43-46.

Russell, Donn H. 1984. An evaluation of farm management microcomputer assisted instruction in Iowa vocational agriculture programs. M.S. Thesis. Library, Iowa State University, Ames, Iowa.

Sistler, E. Fred. 1984. The Farm Computer. Reston Publishing Company, Inc., A Prentice-Hall Company, Reston, Virginia.

Sonka, Steven T. 1983. Computers in Farming: Selection and Use. McGraw-Hill, Inc., New York, New York.

SPSSX User's Guide. 1983. SPSS Inc., Chicago, Illinois.

Starling, John T. and David B. Shewmaker. 1982. How Ohio Teachers Learn Microcomputers. Agricultural Education Magazine 54(7): 11-12.

Taylor, Reed D. and Michael W. Woolverton. 1980. Teaching "Computer Technology for Agriculture" Using Programmable Calculators, NACTA Journal 6: 36-40.

Tsai, San-Yun and Norval F. Pohl. 1983. Student Achievement in Computer Programming: Lecture vs Computer-Aided Instruction. Journal of Experimental Education 46(2): 66-70.

Tuttle, Francis T. and Juanita W. Bice. 1983. Keeping the Profession Current. VocEd Journal of the American Vocational Association 58(8): 32-34.

Urban, Tom. 1984. Challenge to Agriculture: Look Ahead, Not Back. Des Moines Sunday Register (Des Moines, Iowa) Sec. F.

Watkins, Edgar P. 1982. Where Consumers Buy Their Food. Yearbook of Agriculture United States Department of Agriculture, Washington, D.C.

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APPENDIX A

CAI EXAMPLE

The following is an example of the computer-assisted instruction materials used in conjunction with this study. Each frame number represents what the user sees on the monitor when executing the program. The symbol RET means to press the return key to continue. When questions are asked, the user determines the answer mentally, not with the computer.

Frame 1

```
THE
INPUT
COMMAND
```

Frame 2

```
INPUT
*****

THE INPUT COMMAND
TELLS THE COMPUTER TO
OBTAIN DATA FROM THE
PERSON RUNNING THE
PROGRAM.

      <RET>
```

Frame 3

```
THE PROGRAM WILL STOP,
PRINT A QUESTION MARK
(?) ON THE SCREEN AND
WAIT FOR THE PERSON
TO TYPE THE DATA AND
HIT THE RETURN KEY

      <RET>
```

Frame 4

```
10 INPUT B

THE ABOVE LINE CALLS
FOR THE INPUT OF A
NUMERICAL VALUE.
WHEN A NUMBER IS
TYPED IN, THE
COMPUTER ASSIGNS THE
VALUE TO THE LETTER
B.

      <RET>
```

Frame 5

```
10 INPUT B$
```

IF THE SYMBOL $
IS ADDED TO THE
LETTER B, THE
INPUT MUST BE
LETTERS, NOT
NUMBERS

<RET>

Frame 6

```
10 INPUT A
20 INPUT B
30 INPUT A+B
40 END
```

WHAT WILL BE THE
OUTPUT OF THE
ABOVE PROGRAM IF
THE INPUT FOR A
IS 5 AND THE
INPUT FOR B IS
7?

<RET>

Frame 7

```
10 INPUT A
20 INPUT B
30 INPUT A+B
40 END
```

WHAT WILL BE THE
OUTPUT OF THE
ABOVE PROGRAM IF
THE INPUT FOR A
IS 5 AND THE
INPUT FOR B IS
7?

ANSWER: 12

<RET>

Frame 8

```
10 INPUT A$
20 INPUT B$
30 PRINT A,B
40 END
```

WHAT WILL BE THE
OUTPUT OF THE
ABOVE IF A$ IS
SWINE AND B$ IS
CATTLE?

<RET>

Frame 9

```
10 INPUT A$
20 INPUT B$
30 PRINT A,B
40 END
```

WHAT WILL BE THE OUTPUT OF THE ABOVE IF A$ IS SWINE AND B$ IS CATTLE?

ANSWER:
SWINE   CATTLE

<RET>

Frame 10

```
10 INPUT A$
20 INPUT B$
30 PRINT A+B
40 END
```

WHAT WILL BE THE OUTPUT OF THE ABOVE PROGRAM IF A$ IS SWINE AND B$ IS CATTLE?

<RET>

Frame 11

```
10 INPUT A$
20 INPUT B$
30 PRINT A+B
40 END
```

WHAT WILL BE THE OUTPUT OF THE ABOVE PROGRAM IF A$ IS SWINE AND B$ IS CATTLE?

ANSWER:
SWINECATTLE

NOTICE THAT IT ADDED THE TWO TOGETHER

<RET>

Frame 12

INPUT
*****

THE INPUT STATEMENT IS A VERY POWERFUL STATEMENT. YOU WILL LEARN MORE ABOUT IT AS THE COURSE PROGRESSES.

<RET>

Frame 13

YOU ARE WITHOUT A
DOUBT THE SMARTEST
PERSON ON YOUR
STOOL.

SO WHAT DO YOU
DO NOW?

AG MECH 180X
COURSE OUTLINE

DATE		TOPIC	REFERENCE
Jan.	18	The computer, flowcharting, and logical programming	Ch #1, text and handouts
	25	Getting to know your VIC and using the screen and keyboard. Introduction to BASIC	User manual and Ch. #2 text
Feb.	1	Computer terminology, drives, printers and BASIC commands	User manual and Ch #2 text
	8	Input and output	Ch #4 text
	15	Decisions, branching, and applications	Ch #5 text
	22	Looping and functions. Transfer of BASIC to other brands of computers	Ch #6 text and User manual
	29	Subroutines	Ch #9 text
Mar.	19	Transfer of BASIC to other brands of computers	User manuals
	26	EXAM	
Apr.	2	Arrays	Ch #7 text
	9	String variables	Ch #8 text
	16	Random numbers and simulations	Ch #10 text and User manual
	23	Interfacing and disk operating systems of various computer brands	User manual
	30	Graphics, and worksheet programs	Handouts
May	8	Text editing programs and other types of programs on the market	Handouts
		Straight talk concerning using and purchasing software and hardware	Handouts
		EXAM	

APPENDIX B: DEMOGRAPHIC SURVEY

PART I

DEMOGRAPHIC SURVEY

Please answer each of the following questions with an "X" in the space provided.

1. In what type of setting were you raised?

( ) farm
( ) rural area, but not a farm
( ) town or city

2. How many semesters of vocational agriculture did you have in grades 9 through 12?

( ) none
( ) one
( ) two
( ) three
( ) four
( ) five
( ) six
( ) seven
( ) eight

3. Considering all the subjects that you took in grades 9 through 12, in which one did you make the highest grades?

( ) math
( ) science
( ) history
( ) english
( ) other (please describe)____________________
( ) physical education
( ) vocational agriculture
( ) industrial arts

4. Considering all the subjects that you took in grades 9 through 12, in which one did you make the lowest grades?

( ) math
( ) science
( ) history
( ) english
( ) other (please describe)____________________
( ) physical education
( ) vocational agriculture
( ) industrial arts

5. Considering all the subjects that you took in grades 9 through 12, which one did you like the best?

( ) math
( ) science
( ) history
( ) english
( ) other (please describe)____________________
( ) physical education
( ) vocational agriculture
( ) industrial arts

6. Considering all the subjects that you took in grades 9 through 12, which one did you like the least?

( ) math
( ) science
( ) history
( ) english
( ) other (please describe)____________________
( ) physical education
( ) vocational agriculture
( ) industrial arts

7. How many semesters of math did you have in grades 9 through 12?

( ) one
( ) two
( ) three
( ) four
( ) five
( ) six
( ) seven
( ) eight
( ) more than eight

8. What was your average grade in math for grades 9 through 12?

( ) A
( ) B
( ) C
( ) D
( ) F

9. How many words per minute can you type?

( ) Do not type
( ) 1 to 10
( ) 11 to 20
( ) 21 to 30
( ) 31 to 40
( ) 41 to 50
( ) 51 to 60
( ) 61 to 70
( ) 71 to 80
( ) 81 to 90
( ) more than 90

10. How much does your father or male guardian use a computer in his occupation?

( ) very much
( ) much
( ) some
( ) little
( ) none

11. How much does your mother or female guardian use a computer in her occupations?

( ) very much
( ) much
( ) some
( ) little
( ) none

12. What is your present student classification?

( ) freshman
( ) sophomore
( ) junior
( ) senior
( ) graduate
( ) special

13. What is your major?

( ) ______________________________

14. Have you had any experience using a computer?

( ) very much
( ) much
( ) some
( ) little
( ) none

15. Have you received any formal instruction on using a micro-computer prior to this class?

( ) very much
( ) much
( ) some
( ) little
( ) none

16. Have you received any formal instruction on using a mainframe-computer prior to this class?

( ) very much
( ) much
( ) some
( ) little
( ) none

17. Do you own a micro-computer?

( ) yes
( ) no

18. Do your parents or guardian own a computer?

( ) yes
( ) no

19. How many years experience have you had in using a basic calculator?

( ) zero
( ) one
( ) two
( ) three
( ) four
( ) five
( ) six
( ) seven
( ) eight
( ) nine
( ) more than nine

20. How many years experience have you had in using a programmable calculator?

( ) zero
( ) one
( ) two
( ) three
( ) four
( ) five
( ) six
( ) seven
( ) eight
( ) nine
( ) more than nine

21. How many semesters of math have you had at the post-secondary level?

( ) one
( ) two
( ) three
( ) four
( ) five
( ) six
( ) seven
( ) eight
( ) nine
( ) more than nine

22. What is your average grade in math at the post-secondary level?

( ) A
( ) B
( ) C
( ) D
( ) F

23. Approximately how many hours of experience have you had playing video games?

( ) zero
( ) 1 to 10
( ) 11 to 20
( ) 21 to 30
( ) 31 to 40
( ) 41 to 50
( ) 51 to 60
( ) 61 to 70
( ) 71 to 80
( ) 81 to 90
( ) more than 90

24. Have you had employment that attributed to your interest in computers?

( ) no
( ) yes (please describe)____

____.

25. What occupation do you plan to enter upon completion of your formal education?

( )____.

26. What factor most influenced you to take this course?

( ) personal interest
( ) lack of computer expertise
( ) degree requirements
( ) curiosity
( ) Other (please specify)____.
( ) to learn BASIC
( ) easy credit for degree
( ) because it is an Ag Mech course

27. Who most influenced you to take this course?

( ) myself
( ) advisor
( ) relative
( ) other (please specify)____
( ) peer
( ) employer

28. How would you rate your command of the english language?

( ) superior
( ) above average
( ) average
( ) below average
( ) poor

APPENDIX C: ATTITUDE INVENTORY

PART II

ATTITUDE INVENTORY

Please respond to each of the following statements listed, as indicated with an asterisk (*) by marking an "X" on each line at the location which best describes your TRUE feelings. Only one mark per line please.

EXAMPLE OF THE CORRECT WAY TO MARK YOUR RESPONSES:

* I feel that computers are:

1. Worthless	___	___	___	___	X	___	___	Valuable
2. Unimportant	___	___	___	___	___	X	___	Important
3. Unnecessary	___	___	___	___	X	___	___	Necessary
4. Useless	___	___	___	___	X	___	___	Useful
5. Unbeneficial	___	___	___	___	___	X	___	Beneficial

Clarification:

1. Worthless	___	___	___	___	___	___	___	Valuable

A mark here would indicate that you feel computers are worthless.

A mark here would indicate that you feel computers are not necessarily worthless or valuable.

A mark here would indicate that you feel computers are somewhat valuable but not extremely valuable.

* My parents consider computer knowledge for me as:

1. UNNECESSARY : ____: ____: ____: ____: ____: ____: ____: NECESSARY
2. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE
3. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE
4. MEANINGLESS : ____: ____: ____: ____: ____: ____: ____: MEANINGFUL
5. UNIMPORTANT : ____: ____: ____: ____: ____: ____: ____: IMPORTANT

* My peers consider computer knowledge as:

1. UNNECESSARY : ____: ____: ____: ____: ____: ____: ____: NECESSARY
2. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE
3. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE
4. MEANINGLESS : ____: ____: ____: ____: ____: ____: ____: MEANINGFUL
5. UNIMPORTANT : ____: ____: ____: ____: ____: ____: ____: IMPORTANT

* I feel that learning computer programming is:

1. UNREWARDING : ____: ____: ____: ____: ____: ____: ____: REWARDING
2. MEANINGLESS : ____: ____: ____: ____: ____: ____: ____: MEANINGFUL
3. UNDEMANDING : ____: ____: ____: ____: ____: ____: ____: CHALLENGING
4. UNINTERESTING : ____: ____: ____: ____: ____: ____: ____: INTERESTING
5. BORING : ____: ____: ____: ____: ____: ____: ____: INTRIGUING

* I feel that knowing how to write computer programs is:

1. UNIMPORTANT : ____: ____: ____: ____: ____: ____: ____: IMPORTANT
2. UNNECESSARY : ____: ____: ____: ____: ____: ____: ____: NECESSARY
3. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE
4. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
5. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE

* I feel that using a canned program to learn computer programming is:

1. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE
2. MEANINGLESS : ____: ____: ____: ____: ____: ____: ____: MEANINGFUL
3. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
4. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE
5. INEFFECTIVE : ____: ____: ____: ____: ____: ____: ____: EFFECTIVE

* The potential for the use of the computer in university classes would be described as:

1. LIMITED : ____: ____: ____: ____: ____: ____: ____: UNLIMITED
2. SMALL : ____: ____: ____: ____: ____: ____: ____: LARGE
3. DIMINUTIVE : ____: ____: ____: ____: ____: ____: ____: IMMENSE
4. LITTLE : ____: ____: ____: ____: ____: ____: ____: MUCH
5. INSIGNIFICANT : ____: ____: ____: ____: ____: ____: ____: SIGNIFICANT

* The potential for the use of the computer in high school classes could be described as:

1. LIMITED : ____: ____: ____: ____: ____: ____: ____: UNLIMITED
2. SMALL : ____: ____: ____: ____: ____: ____: ____: LARGE
3. DIMINUTIVE : ____: ____: ____: ____: ____: ____: ____: IMMENSE
4. LITTLE : ____: ____: ____: ____: ____: ____: ____: MUCH
5. INSIGNIFICANT : ____: ____: ____: ____: ____: ____: ____: SIGNIFICANT

* The role of computers in my future occupation will be:

1. UNIMPORTANT : ____: ____: ____: ____: ____: ____: ____: IMPORTANT
2. UNNECESSARY : ____: ____: ____: ____: ____: ____: ____: NECESSARY
3. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE
4. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
5. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE

* The role of computers in my home and family life will be:

1. UNIMPORTANT : ____: ____: ____: ____: ____: ____: ____: IMPORTANT
2. UNNECESSARY : ____: ____: ____: ____: ____: ____: ____: NECESSARY
3. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE
4. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
5. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE

* When University studies are considered, knowing how to use a computer is:

1. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
2. UNNECESSARY : ____: ____: ____: ____: ____: ____: ____: NECESSARY
3. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE
4. UNIMPORTANT : ____: ____: ____: ____: ____: ____: ____: IMPORTANT
5. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE

* My present level of computer expertise is:

1. INADEQUATE : ____: ____: ____: ____: ____: ____: ____: ADEQUATE
2. INSUFFICIENT : ____: ____: ____: ____: ____: ____: ____: SUFFICIENT
3. UNSATISFACTORY : ____: ____: ____: ____: ____: ____: ____: SATISFACTORY
4. DEFICIENT : ____: ____: ____: ____: ____: ____: ____: AMPLE
5. LOW : ____: ____: ____: ____: ____: ____: ____: HIGH

* My college education thus far has been:

1. UNDEMANDING : ____: ____: ____: ____: ____: ____: ____: CHALLENGING
2. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE
3. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
4. UNINTERESTING : ____: ____: ____: ____: ____: ____: ____: INTERESTING
5. MEANINGLESS : ____: ____: ____: ____: ____: ____: ____: MEANINGFUL

* My feelings about learning to use the computer could be described as:

1. APPREHENSIVE : ____: ____: ____: ____: ____: ____: ____: CONFIDENT
2. NEGATIVE : ____: ____: ____: ____: ____: ____: ____: POSITIVE
3. FRUSTRATED : ____: ____: ____: ____: ____: ____: ____: PLACID
4. PESSIMISTIC : ____: ____: ____: ____: ____: ____: ____: OPTIMISTIC
5. DISCOURAGED : ____: ____: ____: ____: ____: ____: ____: ENCOURAGED

* Having expertise in computer programming is:

1. UNNECESSARY : ____: ____: ____: ____: ____: ____: ____: NECESSARY
2. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
3. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE
4. UNIMPORTANT : ____: ____: ____: ____: ____: ____: ____: IMPORTANT
5. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE

* Considering employment after graduation, a knowledge of computers is:

1. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
2. UNNECESSARY : ____: ____: ____: ____: ____: ____: ____: NECESSARY
3. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE
4. UNIMPORTANT : ____: ____: ____: ____: ____: ____: ____: IMPORTANT
5. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE

* Computer used as a teaching tool would be:

1. INEFFECTIVE : ____: ____: ____: ____: ____: ____: ____: EFFECTIVE
2. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
3. MEANINGLESS : ____: ____: ____: ____: ____: ____: ____: MEANINGFUL
4. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE
5. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE

* Computers used as a learning tool would be:

1. INEFFECTIVE : ____: ____: ____: ____: ____: ____: ____: EFFECTIVE
2. UNDESIRABLE : ____: ____: ____: ____: ____: ____: ____: DESIRABLE
3. USELESS : ____: ____: ____: ____: ____: ____: ____: USEFUL
4. MEANINGLESS : ____: ____: ____: ____: ____: ____: ____: MEANINGFUL
5. WORTHLESS : ____: ____: ____: ____: ____: ____: ____: VALUABLE

* My feelings about learning to write computer programs could be described as:

1. APPREHENSIVE : ____: ____: ____: ____: ____: ____: ____: CONFIDENT
2. NEGATIVE : ____: ____: ____: ____: ____: ____: ____: POSITIVE
3. FRUSTRATED : ____: ____: ____: ____: ____: ____: ____: PLACID
4. PESSIMISTIC : ____: ____: ____: ____: ____: ____: ____: OPTIMISTIC
5. DISCOURAGED : ____: ____: ____: ____: ____: ____: ____: ENCOURAGED

APPENDIX D: KNOWLEDGE TEST

PART III

KNOWLEDGE TEST

The answers to the following questions were designed in reference to the microcomputer that you will use in this class (Commodore VIC 20). Please answer the following questions to the best of your ability by placing a mark in the space provided.

1. What does BASIC stand for?

   ( ) Basic Associated Symbols In Computers
   ( ) Beginners All-purpose Symbolic Instructional Code
   ( ) Basic Associated Symbolic Instructional Code
   ( ) Beginners All-purpose Symbols In Computers
   ( ) None of the above

2. How do you communicate with the computer that you are finished typing a line or instruction.

   ( ) Press the FINISHED key
   ( ) Press the STOP key
   ( ) Press the END key
   ( ) Type "Enter"
   ( ) None of the above

3. What command is used to display a program on the monitor?

   ( ) RUN
   ( ) DISPLAY
   ( ) MENU
   ( ) LIST
   ( ) None of the above

4. The flashing square light on the monitor screen that indicates where the next character will be placed is known as the what?

   ( ) Illuminator
   ( ) Prompt
   ( ) Cursor
   ( ) Indicator
   ( ) None of the above

5. How do you insert lines while writing a program in BASIC on the computer?

   ( ) Press the INPUT key and then type the line number and program line.
   ( ) Press the INSERT key and then type the line number and program line.
   ( ) Type "Insert" and then the line number and program line.
   ( ) Type the line number and then the program line.
   ( ) None of the above

6. When scanning arithmetic expressions, the computer reads in what direction?

   ( ) Left to right
   ( ) Right to left
   ( ) Top to bottom
   ( ) Bottom to top
   ( ) None of the above

7. What command is used to execute a program?

( ) RUN
( ) EXECUTE
( ) PRINT
( ) RETURN
( ) None of the above

8. If we execute this program, what is the result that will be printed?

```
125 LET D=B-A
135 PRINT D
```

( ) B-A
( ) SYNTAX ERROR IN 125
( ) D
( ) Ø
( ) None of the above

9. If we execute this program, what is the result that will be printed?

```
100 LET A = 110
110 PRINT A
120 LET A = A+1
130 GOTO 110
140 END
```

( ) 110
111
( ) 110
A+1
( ) 110
( ) 110
SYNTAX ERROR
( ) None of the above

10. When the following program is carried out by the computer, what result will it print?

```
100 LET A = ((2↑2*6/3) + (8/2↑2+8) -((24/3-5)*5))/2
110 PRINT A
```

( ) 1.5
( ) -21
( ) 8.5
( ) -14
( ) None of the above

11. What will be printed if you execute the following program?

```
100 LET D=B
110 LET B=5
120 LET C=D+B+B
130 PRINT C
140 END
```

( ) 10
( ) 15
( ) Ø
( ) 5
( ) None of the above

12. What is the purpose of the REM statement in a program?

( ) It allows the operator to use a remote terminal.
( ) It allows the operator to use any of a number of remote devices, including terminals, printers, monitors, and disc drives.
( ) It allows the operator to put data or statements into the program that have no effect on the program.
( ) It allows the operator access to the Read Only Memory.
( ) None of the above

13. Which of the following would be the most concise BASIC statement that the computer could use to evaluate the following expression?

$$A = (4+3B/D)^2$$

( ) LET A = $(4+3B/D)^2$
( ) LET A = $(4+3*B/D)^2$
( ) LET A = (4+3*B/D)↑2
( ) LET A = $((4+3)*(B/D))^2$
( ) None of the above

14. What will be printed if you execute the following program?

```
100 READ A, B,C,D
110 E = A+B+C+D
120 PRINT E
130 DATA 25,3,17,12
140 END
```

( ) E
( ) A+B+C+D
( ) 25+3+17+12
( ) Ø
( ) None of the above

15. In the problem below, supply the missing statements so that when A and B are printed out, the values have been interchanged.

```
100 INPUT A,B
110
120
130 PRINT A,B
140 END
```

( ) 110 INVERT A=B
120 INVERT B=A

( ) 110 INPUT B=A
120 INPUT A=B

( ) None of these

( ) 110 B INVERT A
120 A INVERT B

( ) 110 C=A: A=B
120 B=C

16. What will be printed if you execute the following program?

```
110 READ A,B,C
120 PRINT E
130 PRINT A  PRINT B  PRINT C
140 DATA 66,88,22
150 END
```

( ) 66 88 22
( ) E
A B C
( ) Ø
66 88 22
( ) Ø
66
88
22
( ) None of the above

17. What will be printed if you execute the following program?

```
110 HEAT$ = "HORSE"
120 HEAR$ = "COW"
130 PRINT HEAR$, HEAT$
140 END
```

( ) COW HORSE
( ) SYNTAX ERROR IN 100
( ) HORSE COW
( ) COW COW
( ) None of the above

18. In the above program, the word "HORSE" is known as a:

( ) Variable String
( ) Variable
( ) Value
( ) Character set
( ) None of the above

19. What will be printed if you execute the following program?

```
100 READ X,Y,Z
110 DATA HEAR$, HEAT$, HEAP$
120 PRINT X;Y;Z
130 END
```

( ) X Y Z
( ) HEAR$ HEAT$ HEAP$
( ) Ø Ø Ø
( ) HEAR HEAT HEAP
( ) None of the above

20. What will be printed if you execute the following program?

```
110 READ X$,Y$,Z$
120 HEAR$ = "COW "
130 HEAT$ = "HORSE "
140 PRINT HEAT$;HEAR$
150 PRINT X$;Y$;Z$
160 DATA "DOG ", "CAT ", "BIRD "
170 END
```

( ) HEAT$ HEAR$
X$ Y$ Z$

( ) HORSE COW
DOG CAT BIRD

( ) COW HORSE
DOG CAT BIRD

( ) HORSE HORSE
DOG CAT BIRD

( ) None of the above

APPENDIX E: HUMAN SUBJECTS APPROVAL FORM

INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH
IOWA STATE UNIVERSITY
(Please follow the accompanying instructions for completing this form.)

1. Title of project (please type): A COMPARISON OF THREE APPROACHES TO TEACHING COMPUTER PROGRAMMING

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

TIMOTHY A. WIGGINS — Typed Named of Principal Investigator
6/6/83 — Date
Timothy A. Wiggins — Signature of Principal Investigator

212 Davidson Hall — Campus Address
294-1320 — Campus Telephone

3. Signatures of others (if any) | Date | Relationship to Principal Investigator

Signatures of others (if any)	Date	Relationship to Principal Investigator
David L. Williams	6-7-83	Major Professor

4. ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

- [ ] Medical clearance necessary before subjects can participate
- [ ] Samples (blood, tissue, etc.) from subjects
- [ ] Administration of substances (foods, drugs, etc.) to subjects
- [ ] Physical exercise or conditioning for subjects
- [ ] Deception of subjects
- [ ] Subjects under 14 years of age and(or) [ ] Subjects 14-17 years of age
- [x] Subjects in institutions
- [ ] Research must be approved by another institution or agency

5. ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

- [ ] Signed informed consent will be obtained.
- [x] Modified informed consent will be obtained.

6. Anticipated date on which subjects will be first contacted: Month 6 Day 13 Year 83

Anticipated date for last contact with subjects: Month 2 Day 23 Year 84

7. If Applicable: Anticipated date on which audio or visual tapes will be erased and(or) identifiers will be removed from completed survey instruments: Month ___ Day ___ Year ___

8. Signature of Head or Chairperson | Date | Department or Administrative Unit

H. R. Crawford — 6-7-83 — Ag Ed Dept

9. Decision of the University Committee on the Use of Human Subjects in Research:

- [x] Project Approved
- [ ] Project not approved
- [ ] No action required

George G. Karas — Name of Committee Chairperson
6/9/83 — Date
G. G. Karas — Signature of Committee Chairperson

Revised 6/78