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EFFECTIVENESS OF A COMPUTER ASSISTED INSTRUCTION

PROGRAM FOR TEACHING CONSUMER CREDIT TO

SECONDARY HOME ECONOMICS STUDENTS

by

Ann Horne Faircloth

A Dissertation Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
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Approved by

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APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of the Graduate School at The University of North Carolina at Greensboro.

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FAIRCLOTH, ANN HORNE, Ph.D. Effectiveness of a Computer Assisted Instruction Program for Teaching Consumer Credit to Secondary Home Economics Students. (1984) Directed by Dr. Barbara N. Clawson. 119 pp.

The purposes of this study were to develop and field test a microcomputer program, to determine whether students learned more using the software than from reading similar material, and to examine relationships between amount of information learned and four selected variables. A sample of 68 pupils divided into experimental and control groups was selected randomly from a population of secondary home economics students.

Instruments developed for this study included a 17-item knowledge test used as pretest, posttest, and second posttest a week later and two questionnaires with Likert-type scales intended to assess student attitudes toward computers and familiarity with computers. Responses indicated that experimental group participants strongly agreed or agreed that computers are useful, that knowing about computers can be helpful when seeking employment, that computer games are exciting, and that computers can be used for teaching. Most students in the experimental group did not use computers at home or school to any great extent.

Instructional materials related to consumer credit were designed for both computer assisted instruction (CAI) and reading. The microcomputer program consisted of dialogue and drill and practice modules, and the reading material included text with questions concluding each section.

An analysis of variance was used to test Hypothesis 1 which stated that there was no difference in mean gain scores on a test on consumer credit between the experimental group instructed by microcomputer and the control group who read similar material. Results of the ANOVA indicated that Gain 1 (pretest to posttest) and Gain 2 (pretest to second posttest) were statistically significant, with the experimental group scoring higher than the control group.

Testing of Hypothesis 2, which stated that there were no relationships among IQ, grade point average, interest in computers, or familiarity with computers and amount of information learned via CAI, was performed using three stepwise multiple regressions. Results revealed no significant relationships between these variables and mean gain scores.

This dissertation is dedicated to the memory of my mother, Grace Ezzell Horne.

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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

CHAPTER I

INTRODUCTION

Technology and education have formed a natural linkage throughout the history of civilized man. In the beginning most learning took place as individuals interacted with other people and the environment by generalizing on the basis of that interaction, a method of learning rich in experience and similar to childhood play. Later, when written language was developed, it was a very positive step both in human history and in education. The invention of the printing press provided another milestone in the evolution of learning, and about 200 years later textbooks came into extensive use as instructional tools. Still an important resource which is supplemented by various other media, textbooks can no longer stand alone as the primary source of learning for students, because rapid changes brought about by science and technology and the ensuing expansion of knowledge demand new direction (Ryba & Chapman, 1983; Taylor, 1980).

The curriculum in the average American school today is designed to respond to the needs of an industrial economy, i.e., a former era when workers were required "to possess basic skills, to be prompt, to work on routine and repetitive tasks, and to follow instruction" (Deringer, 1983, p. 25).

The high technology/information industries of today demand workers with backgrounds in science, mathematics, and computer science, and industries of the future are expected to include few openings for the undereducated. "Skills today that are considered high level, such as problem solving, creativity, analysis, synthesis, critical thinking, and communication will become essential for many workers" (Lewis, 1983, p. 10). For this reason, schools must redirect curriculum designs to meet demands of a more complex workforce by shifting from a teaching/learning model based on human instruction to a new age combining teachers and machines. Impetus will be provided by financial pressures and a desire to produce a workforce capable of competing in an automated marketplace with international scope (Dede, 1983; Deringer, 1983).

Dede (1983) has suggested that a way to design curriculum to meet changing roles is to divide education and training so that educational functions would be performed by teachers and training would be carried out by computers. In every discipline there is an ever-increasing collection of basic material which must be taught to students, and for most instructors, the repetitive rehashing of this information is boring. Consequently, a means to present prerequisite material effectively would be welcomed. Often the teaching of these fundamentals can be assigned to an inanimate teaching system such as the computer. Moreover, there is evidence that for such tasks "inanimate systems are more consistent and rational because of their infinite patience" (Rockart, Morton, & Zannetos, 1971, p. 17). In most cases such systems are "faster, do not require as much redundancy for purposes of communication (because of their capacity to reproduce accurately the desirable behavior), and allow decentralized control" (Rockart et al., 1971, p. 17).

Schools have used large computers primarily for research and administrative applications and smaller microcomputers for instruction in the past. The microcomputer lends itself to educational applications since it is usually small enough to fit on the top of a desk. Its major components include a keyboard used for input, a central processing unit located on a silicon-based microprocessor chip used for interpreting and controlling information flow, a memory for data storage, and an output device such as a television screen, monitor, or printer. A major factor affecting the widespread use of computers has been the development of semi-conductor chips, each about two-tenths of an inch on a side, with processing capabilities that have "doubled every 14 to 15 months since the mid-1960's" (Grayson, 1981, p. 15).

The National Center for Education Statistics reported that about 40% of the country's schools provide students with access to at least one microcomputer or computer terminal (Maddux & Johnson, 1983) used mostly at the secondary school level, especially in the states of California, Minnesota, Texas, and Massachusetts (Gray, 1982). During the 1981-82 school year there were 120,900 microcomputers or terminals in instructional use in 29,000 public elementary and secondary schools in the United States (Bureau of the Census, 1983). Babb (1982) indicated that "75 percent of high school students have computer experience by graduation" (p. 12). By 1986, it is estimated that 887,000 microcomputer units will be sold to educational markets. In addition, by 1990, 50-80 million people will have purchased home computers so that more students will have home access (Pressman & Rosenbloom, 1984).

Evidence abounds that microcomputers will play an influential role in education during the 1980's. Bear (1984) noted that their growth has been augmented by the belief that microcomputers will improve instructional effectiveness in schools; however, the impetus to promote microcomputers has not evolved from within the field of education.

> For the most part, the advocacy of microcomputers in education has come, not from college trainers or from educators in the field. Nor has it originated as a response to research documenting its effectiveness. (p. 11)

The pressure to implement microcomputer projects can be largely attributed to the mass marketing strategies employed by the manufacturers of hardware and software (Bear, 1984). The computer education market is estimated at up to $100 million annually. "To penetrate the market, the computer companies have given away millions of dollars' worth of equipment to cash-strapped school districts" (Kindel & Benoit, 1984, p. 132) in an effort to build brand loyalty for the future. This is not to say that educators are not interested in utilization of new technology such as microcomputers to cut the cost of education and make it more efficient and effective. Pressman and Rosenbloom (1984) listed four factors that have hampered the development of CAI programs: (a) difficulty in courseware development, (b) lack of training of teachers and administrators relative to computers, (c) hardware and software compatibility, and (d) cost.

Ebel (1982) stated that "no instructional program should be undertaken or continued in the absence of evidence of its effectiveness in producing learning" (p. 375). Schools should systematically examine whether computer assisted instruction (CAI) is having any significant impact on student learning. Using microcomputers for convenience and labor-saving cannot justify the expense and effort their acquisition requires (Bear, 1984; Maddux & Johnson, 1983).

Although there have been numerous studies related to the effectiveness of education in general, only a limited number have focused on the effectiveness of recent methods of instruction such as computer assisted instruction, commonly called CAI. Consequently, this study was designed to compare two instructional media, supervised reading and computer assisted instruction, in terms of effectiveness.

Purposes and Objectives

Since microcomputers are becoming more prevalent in classroom applications and software appropriate for use in home economics classes is limited, this study was designed to investigate the broad spectrum of computer utilization in schools with emphasis on secondary settings and to develop software for a specific unit of study in home economics.

The objectives of this study were as follows:

1. To develop and field test microcomputer software on consumer credit.
2. To determine whether students who were taught by computer exhibit a greater increase in gain scores on a consumer credit test than those who read similar material.
3. To examine relationships between amount learned (gain scores of the experimental or "treatment" group) and grade point average, IQ, computer familiarity, and student attitude toward computers.

Statement of Hypotheses

The hypotheses stated in null form to be tested were as follows:

H_1: There is no difference in mean gain scores on a test on consumer credit between the treatment group instructed by a microcomputer program and the control group who read similar material.

H_2: Neither IQ, grade point average, computer familiarity, nor attitude toward computers affect the amount of information learned by students who complete a unit on consumer credit taught via microcomputer.

Limitations of the Study

Several limitations of the study were acknowledged. Students who participated in the study were limited to tenth, eleventh, and twelfth graders in a public high school in rural North Carolina who were enrolled in at least one home economics course. In the opinion of the teachers, all students included in the study could read well enough to comprehend the instructional materials used as treatment for the study. Consequently, generalizations about the study were restricted to populations similar to that from which the sample was selected.

A second limitation was the fact that only one unit of instruction, that of consumer credit, was selected. The methods of instruction were limited to computer assisted instruction and reading. The information that could be presented was limited in that only one method rather than a combination of methods was used to teach the topic.

Generalizations regarding the effectiveness of computer assisted instruction cannot be made with regard to other subject matter areas nor can one generalize about the usefulness of computers in combination with other teaching methods.

The computer program used was individualized, interactive, and provided immediate feedback through dialogue and drill and practice. There was no speech component but sound and color were used to provide variety, especially with respect to right and wrong answer routines. A modified version of the game format was employed in the drill and practice so that students were given points for correct answers. Students were required to type answers. Generalizations regarding the effectiveness of microcomputers in education can be made only in relation to the computer software and the methods of student interaction with the computer used.

Definition of Terms

The following terms have been defined to provide clarity and consistency throughout the study:

Computer based instruction includes two general categories of direct instruction and instructional management (Grayson, 1981).

Computer assisted instruction (CAI) refers to activities such as drill and practice, tutoring, simulations and gaming, inquiry and dialogue, information retrieval, problem solving, and demonstration (Dede, 1983; Grayson, 1981).

Computer managed instruction encompasses instructional support functions such as testing, diagnosing, recordkeeping, scheduling, monitoring, and time and resource management (Grayson, 1981).

Computer anxiety refers to the fear expressed by persons unfamiliar with computers, sometimes called computerphobia.

User friendliness refers to the ease with which a computer can be manipulated. A user-friendly program is one that requires little time to learn, offers on-screen prompts, protects the user from making disastrous mistakes, or refers to the user by name (Salisbury, 1971).

BASIC (Beginner's All-Purpose Instruction Code) is the computer language used for this study.

Individualized learning defines the learning situation in which the student works alone and controls the pace of the learning.

Hardware includes the computer and its peripherals such as printer, monitor, and disk drive.

Software refers to computer programs.

Program refers to a "sequence of statements in some programming language which directs the computer to perform a given task" (Brooks & Lyon, 1972, p. 45).

CHAPTER II

REVIEW OF LITERATURE

This study focused upon use of computers as an instructional aid in the secondary classroom and the development and testing of microcomputer software for teaching a unit on consumer credit to high school home economics students. Because of the scarcity of information relating to utilization of computers in the area of home economics, this review outlines factors which influence educational applications of computers and discusses computer assisted instruction (CAI), its early stages of development, potential uses, and positive applications. Also included is a review of literature on developing CAI software, evaluation studies, teacher and student responses, and home economics utilization.

Factors Influencing Educational Application of Microcomputers

Education is in the initial stages of a major revolution intensified by the computer. It is expected that interactive use of computers will be the major method of learning at all levels and in almost all subject areas by the year 2000. Bork (1980) stated that the form the revolution will take and the magnitude of the computer's role are unknown at this time for two reasons. First, technological innovation has occurred so rapidly that even those directly involved have difficulty keeping abreast of happenings. Secondly, the effort to apply computers to education is less than 30 years old. With the advent of the microprocessor and the prospect microcomputers

> afford of widely available computing power, thousands of educators and parents are beginning to seriously ponder what the role of computing will be in human learning and what action they can and should take to effect it. (Bork, 1980, p. 32)

What the computer can really do no one knows. Educators are just beginning to explore possibilities of what it is capable of achieving in both learning and teaching. White (1983) predicted that demands on both teacher and learner will be different in the future in that children will rely more on imagery comprehension than on word comprehension and and more will be learned from graphics than from the alphabet.

Review of current literature indicated that there are three primary factors which influence educators in their decisions to incorporate computers into the curriculum: preparation for work, reduced cost and increased availability, and enrichment of education.

Preparation for Work

One reason for including computers in the classroom is the expectation that students need exposure to computers in preparation for work. The United States Labor and Commerce

Departments predicted that 50-75% of American jobs will involve computers by 1990 (Corson, 1982). Already "ten to twenty hours of hands-on computer experience translates into a $1,000 annual advantage in the job market" (Gray, 1982, p. 23). Future job growth in the United States will favor professional and technical jobs that require considerable education and training in computer-related areas. In addition, technology will require upgraded skills because workers will be using computers and other technical equipment (Gray, 1982). Given this expectation, educators feel the need to close the gap between computer literacy and computer ignorance, one which seems to be widening (Tanner & Armstrong, 1983).

Levin and Rumberger (1983), however, expressed an opposing viewpoint and maintained that increased numbers of high technology industries and products will very likely reduce the skill requirements of workers rather than upgrade them. Consequently, expansion of the lowest skilled jobs will vastly outstrip the growth of high technology jobs. Computer-related occupations span a broad spectrum and "include creative jobs designing number-crunching supercomputers to grinding away listlessly on word processors or computer terminals" (Corson, 1982, p. 33). The problem as summed up by Corson is that "computer-related jobs do not require computer literacy; most demand nothing more than keyboard competence" (p. 33).

Reduced Cost/Increased Availability

A second influence on increased incorporation of computers into classrooms is that the cost of computers is declining and software is becoming more readily available. During the 1950's when CAI was first developed, hardware costs were substantial, usually involving large centralized computers which controlled several terminals. Such systems required both a large initial investment and a systems programming commitment (Pressman & Rosenbloom, 1984). At that time, a large time-sharing system could cost $10,000 per terminal, plus $800 per month for usage fees (Braun, 1980). Today's typical microcomputer system "costs between $800-$3,000, depending on the system's capabilities and peripheral devices. These reduced hardware costs have been the major impetus for a recent dramatic rise in CAI" (Pressman & Rosenbloom, 1984, p. 185) use in educational institutions.

Even though the cost has declined, the price must be paid by someone and therein lies concern for equal access to this new technology. Since schools depend on local property taxes for most of their operating revenue, the wealth of a community largely determines the wealth of and, thus, availability of technology in its schools. While the price of computers has fallen, they are still not within reach of many low-income school districts (Corson, 1982; Gray, 1982). A survey by Market Data Retrieval reported in Black Enterprise (Gray, 1982) indicated that school districts with the highest proportion of poor students, generally those with the largest black student populations, have the least number of computers. Moreover, as reflected in this survey, major computer companies dealing in educational programming concentrate their sales promotions in affluent districts which provide a broader market and higher potential sales.

Enrichment of Education

There are several instructional applications of computer which form a continuum ranging from drill and practice, testing, and tutorials at one end to student-controlled activities such as open-ended problem solving and student-developed simulations at the other (Dover, 1983). A discussion of some of the features of microcomputers which make them valuable as teaching aids follows.

Interactive learning. Bork (1980) indicated that the most valuable aspect of the computer for educational use is that it allows learning to be interactive, with students constantly acting as participants in the process rather than as spectators. The speed of its responses is powerful reinforcement. "Students learn faster when they are told immediately that their replies are right or wrong and when they are given the opportunity to correct their own errors" (Campbell, 1984, p. 332). It is important to note, according to Bork (1980), that the student is not conversing with the computer but with the author/creator of the software who has created a whole collection of dialogues directed to individual students.

Individualization. Another feature of computer technology is that learning can be tailored to the individual need of the student. Learning experiences for each pupil can be unique and modified as needed, i.e., programs branched to provide extra practice for those students needing more detailed or repetitive work (Depover, 1982). Many user-friendly programs refer to the student by name. Bork (1980) saw individualization as a humanization of education, especially when compared to teaching in lecture situations with large groups.

Anonymity. Some students prefer to deal with learning material in an impersonal manner since even the best teachers are not immune to personal biases (Bork, 1980). While some students have no fear of being wrong, others are less willing to risk the ridicule of making a mistake when observed by others. The computer allows all students to try out their ideas and gain confidence in them without public exposure in the early phase of their experimentation (Campbell, 1984).

Student-controlled pacing. Since students learn at varying rates, it is advantageous for instructional material to be presented at a rate determined by the learner. This is one method in which the learner exercises control over the timing and pace of his learning experience (Naiman, 1983). Campbell (1984) has stated that computers treat all students alike in that they wait for the slow learner and progress at a more rapid rate for the brighter student. While using computers, students compete with their own past achievement rather than with other students.

Simulations. The computer can amplify everyday experiences by creating worlds which are not available in convenient form for students to explore; i.e., it is difficult to expose students to simulation in the computer sense in a lecture/discussion type of classroom situation. Thus, realms of experience can be created through simulations with the hope of enriching the formal learning environment (Bork, 1980).

Intellectual instrument. The computer is challenging. It stimulates the student, stretches his thinking, and "provides an immediate and pertinent application for skills learned in class" (Campbell, 1984, p. 333). By using computers and becoming familiar with them, students grow up feeling that the computer is a natural tool for use in a variety of different areas. Such a tool "will become as important as reading, writing, and arithmetic in the future" (Bork, 1980, p. 61).

Computer Assisted Instruction

Taylor (1980) suggested that computer usage in educational settings can be divided into three categories: tool, tutor, and tutee. Use as a tool included activities which relate to word processing and data management, and in the case of education, to administrative functions of grading, recordkeeping, scheduling, and statistical analysis. Such was the early use of computers in education (Hartman, 1971; Senter, 1981; Stewart, 1982). As a tutor the computer must be programmed by an expert to teach subject matter to students in an interactive manner. Taylor (1980) referred to programming the computer to perform a task of the student's creation as the tutee category. In this situation the student is in control of the computer. While all three aspects of computer use in educational settings are very important, the focus of this study is on the tutor aspect, i.e., computer assisted instruction.

Early Stages of CAI

Initial attempts to apply computers to education can be traced to the late 1950's with activities at IBM to develop the Coursewriter language and at the University of Illinois where work began on the PLATO system (Grayson, 1981). During the 1960's, there was much interest in CAI delivered on large, centrally located mainframe computers which were expensive and unreliable (McDermott & Watkins, 1983). In addition, they required elaborate telephone connections and special humidity and temperature controls (Caldwell, 1982).

In 1969 Oettinger wrote about some of the problems that schools were having in their attempts to use modern technology without a clear assessment of its role; however, he wrote glowingly of the potential value of a computer-aided instruction system which could provide "a private tool for the learner, animated blackboard for the lecturer, or anything in between" (Oettinger, 1969, p. 214). Kemeny (1972), who developed the computer language BASIC, envisioned a man-computer partnership which would bring about a new golden age for mankind. As president of Dartmouth College, Kemeny required students to enroll in programming courses, an indication of his belief in the importance of computers to education.

Then in the mid-1970's when interest had declined, the microcomputer was developed. This "small, cheap, efficient machine, the Model 'T' of the computer industry" (Holmes, 1982, p. 10) revived interest and enthusiasm for CAI. Since then there has been a great deal of effort to apply computers to education, although the intensity has varied over time. Presently, the use of computers for direct instructional presentation has not yet fulfilled its total potential; however, computers have become important and even essential elements in education (Grayson, 1981).

Potential Uses of CAI

Suppes (1966), perhaps the best known early advocate of CAI, described its potential in these terms:

> One can predict that in a few more years millions of school children will have access to what Philip of Macedon's son Alexander enjoyed as a royal apprentice, the personal services of a tutor as well-informed and responsive as Aristotle. (p. 207)

Ragsdale (1982) contended that one of the consequences of searching for ways to use computers has been a tendency to build from computer strengths rather than to build toward student weaknesses. Educators have had a tendency to use computers for instruction of skills made less important by electronic technology because it is easier to develop CAI lessons for tasks which computers do very well. For example, there are more CAI programs available for mathematics (one estimate of 95%) than for any other subject taught in schools (Ragsdale, 1982).

Acting as the teacher's adjutant, the microcomputer provides the hardware to promote a reasonable, valid, and reliable relay of information to the student in areas of drill, instruction, and evaluation. It can also track performance and progress of each student, compare that progress with prescribed norms, and schedule each student for the appropriate level of instructional activities indicated by his performance (Wholben, 1982).

<u>Positive Applications/Implications of CAI</u>

Well-designed CAI programs make possible quality interactions between the disseminator of information (the computer) and the learner. It is possible for computer courseware to provide for a much higher frequency of these interactions than is possible between teacher and learner in the traditional classroom setting. The result of this frequent interaction has the potential to reduce learning time (Tanner &

Armstrong, 1983). Senter (1981) found that computer assisted instruction reduced by 20-50% the time required for students to learn a subject with the same level of proficiency so that 1 hour of computer assisted instruction may be as valuable as 2 hours of traditional teaching.

Those favoring expansion of CAI contend that such training develops students' problem-solving skills. Tanner and Armstrong (1983) found that problem-solving skills could be practiced, improved, and evaluated on a microcomputer and that computers had a strong motivational influence on youngsters.

Computers are an excellent medium for educational gaming activities. Kee (1981) provided evidence relating to factors which make computer games fun. Experiments with elementary school children indicated that games with graphic illustrations were preferred over those without and that goal-oriented games were preferred over those with no definite goal. Students with more computer experience tended to rate games lower than did students with less computer experience.

Gagne (1974) identified the following five categories of learning outcomes:

1. Information--learning that encodes entities, properties, states, action, concepts, or rules that are related to each other in particular ways.

2. Intellectual skills--acquisition of mental procedures for classification and rule application.
3. Cognitive strategies--internally organized capabilities which govern cognitive processes. When these strategies are acquired, the student knows how. Examples are to learn, to remember, and to understand.
4. Attitudes--learned internal states that affect preference toaard activities, entities, persons, or events.
5. Motor skills--the acquisition of individual motor actions and the control of a sequence of such actions that make a complete performance.

Playing with handheld electronic and microcomputer games can potentially have implications for all of the types of learning identified by Gagne (1974).

A feature common to most of the computer games is the creation of a rich environment for children to invent, discover, practice, and to modify their use of cognitive strategies (Kee, 1981). Interactive technology is attractive both to educators and students. White (1983) reported on studies which changed software, characteristic by characteristic, to determine what aspect was most appealing to students. Results indicated that "the idea of a challenge, the involvement of fantasy, and the game format" (p. 14) were most appealing to participants. Gaming usually fulfills the requirement that software should not be too easy nor too difficult and should progress at a speed which guarantees student involvement. Well written software insures pupil alertness, and "an alert student tends to be a learning student" (p. 15).

A pilot study at the Electronic Learning Laboratory revealed that pupils involved with computers ask more questions than those in traditional classroom setting, a finding contradictory to the notion of children sitting in front of computers like robots (White, 1983).

In summary, much can be said on the positive side for computers. They are smaller, cost less, are appealing to students, and can be used in a number of ways to enrich education. A system that once required a room can now fit on the top of a desk. Sujka (1981) estimated the average cost per hour of CAI to be $1.32, compared to $2.00 per hour for traditional instruction. Above all, the computer is challenging in that it stimulates the students, stretches their thinking, and provides an immediate application of skills learned in class (Campbell, 1984).

A Negative View: Problems Associated with CAI

Most of the problems related to CAI pertain to software. Speaking to this issue, Daneliuk and Wright (1981) commented that the three major problems with computer courseware are that there is little available, what is available is often mediocre, and even good courseware needs adapting to individual needs.

Much of the available software and hardware were initially developed for use in nonschool settings. This situation has presented problems for school districts which initiated computerized educational programs without first studying the situation (Tanner & Armstrong, 1983). Many attempts at producing software resemble "electronic books which require the learner to turn pages by means of a series of key presses" (Caldwell, 1982, p. 45).

In most CAI, the nature of the teaching would not require a computer. Text is presented and read, questions are asked, and materials are presented or reviewed depending on the answers of students. The two problems associated with this approach are that computer capabilities are underused and the requirement to present instruction and tests in text form makes learning more difficult for many tasks (Montague, 1982; Morris, 1983; Ryba & Chapman, 1983).

Some have argued that problems with present courseware can be solved by training professional educators who are already well versed in principles of instructional design to become computer programmers. The idea does have merit, but such training is costly; and even when training has been provided, teachers may find it difficult to devote sufficient time to courseware development. It is estimated that every hour of CAI required 20 to 200 hours of writing time (Tanner & Armstrong, 1983).

Many of the more popular programming languages are characterized by complexities that are frustrating and consequently discouraging to would-be programmers. No single available programming language, authoring language, or authoring system provides all the needed facilities for generating CAI (Hazen, 1982).

While hardware has become less expensive, software remains the most costly component of CAI. In many situations, school personnel ordered computers with the expectation that teachers would write programs or obtain software at little or no cost. But, much of teacher-designed software is so poor in quality that it is almost useless. When publishers and other large-scale materials developers began to develop courseware lines, the price tag for these products was much higher than anticipated. Perhaps because initially software was so inexpensive, educators are still shocked by prices of preprogrammed materials (Roblyer, 1983).

The days of system-restricted software are numbered with software material being coded for accessibility to many of the more popular hardware models on the market. Textbook publishers are using research and development energies toward designing microsoftware compatible with major hardware systems and parallel to their texts. Traditionally, educators selected software first and then chose compatible hardware; schools which chose in reverse order are feeling the need to develop their own software (Wholben, 1982).

The problems of microcomputer software have been summed up by Papert (1980). He stated that current CAI is automation, not innovation, and programs represent traditional curriculum ideas, only in a mechanical form. "Most of what has been done up to now under the name of educational technology or computers in education is still at the stage of linear mix of old instructional methods and new technologies" (p. 19).

Designing Computer Assisted Instruction

In recent years a new cognitive science has been developed which involves the psychology of human comprehension, problem solving, and learning. This science is beginning to provide a firm foundation of knowledge about how people comprehend what they read and observe, how they solve problems, and how they gain skill in these and other intellectual activities (Lesgold & Reif, 1983). Design of educational material using the computer as a medium can incorporate many of the principles of learning inherent in this science. In fact, to do so is a must for effective computer assisted instruction.

Cognitive theoreticians suggest that there are no longer good and bad students but that modern students require more skilled methods of teaching. Kean and Laughlin (1981) have stipulated that the best learning exists when learners accept responsibility for planning and operating a learning process. This methodology requires student participation in determining educational needs and setting learning goals, and in turn, the student is provided immediate feedback through the learning procedure.

In order for students to learn, they must perceive, or become aware of the material which is presented to them. A perception model reported by Kean and Laughlin (1981) includes several steps performed in order. First, the learner screens stimuli, then he attends to them at some level, interprets them in some manner, and establishes some level of cognition. The cognitions, in turn, become part of the learner's memory bank through the process of learning. Thus, learning strategies need to be built upon the process of perception and be adaptable to the present knowledge of cognitive learning style. Well designed interactive computer software may be a tool for optimizing the learning environment for most students (Evans, 1982).

Cognitive science is becoming increasingly applied to the design of CAI with goals of improving quality and increasing quantity of the information which can be processed by the learner. According to Evans (1982), the two features of computers which are especially important to design of instructional materials are their capacity for interactive feedback and individualization of subject matter.

Also important to learning is instructional design which ensures that students can recall what they have learned when that information is needed. Human memory is one of the most extensively studied areas in cognitive science, and much has been learned about it. A primary principle is that human memory access is contextually controlled so that, regardless of the level of processing, information learned is best remembered within the context of other information processed at the time of storage (Evans, 1982).

> This fact is clear from a number of examples in literature, and mnemonic devices are one of the most spectacular means of improving memory. These contexts vary from single words to entire verbal passages, to visual scenes, and even environmental situations. The prevalence of this finding is reflected in the fact that most theoretical models of memory are designed to account readily for the associationistic operation of memory. (Evans, 1982, p. 10)

In order for CAI modules to build information which can be remembered at appropriate times, it is necessary to design them to teach the desired knowledge and skills within the context of the situations to which that information is relevant. Evans (1982) called this problem-oriented instruction. A result of this type of structure is that situations requiring knowledge and skills will provide cues to the student to facilitate recall.

Another factor which facilitates learning is graphical and spatial illustrations, tasks at which the computer is a master. Montague (1982) indicated that considerable research concerned with the role of spatial representation, graphical presentation, and imagery in learning and instructing provides the basis for advancement in teaching techniques. The four areas of cognitive research that have implications for instructional design of interactive learning devices are as follows:

1. <u>Organization</u> is important in learning, reading, and comprehension, since structures in the student's mind interact with the structure of the information presented. Research on problem solving also reveals the importance of structure since the quality of representation of the problem affects the adequacy of the solution. Structuring procedures to guide novices in problem solutions have been shown to produce substantial improvement in performance (Montague, 1982).
2. The role of <u>spatial representations and imagery</u> in learning, remembering, and performing is also important. Research indicated that subjects learn arbitrary lists of words faster when told to imagine visual scenes, although "it seems unlikely that visualization will play the same role in learning complicated tasks" (Montague, 1982, p. 4). Most computers can display simple line graphics, fully animated pictures, or highlighted text to accentuate points or demonstrate concepts (Caldwell, 1982).
3. It is common practice to introduce a new topic by <u>analogy</u> to a familiar situation, but when doing so, the instruction must be careful to choose an appropriate analogy because those that elicit

erroneous inferences can interfere with learning rather than promote it. "Animated visual analogies have been suggested as important in teaching invisible processes, or in understanding complex sequences of events in science" (Montague, 1982, p. 4).

4. Computer assisted instruction needs <u>instructional task fidelity</u> in that the form of the presentation be understandable to the learner, conditions be provided that support learning, and misunderstandings be detectable by testing. Instructional task fidelity requires both the design of the appropriate representations for learning and the inclusion of the necessary learning principles that support acquisition (Montague, 1982).

Guidelines for designing interactive learning material which incorporates principles of cognitive science proposed by Caldwell (1982) included these steps: (a) introduction of concept or problem, (b) extending the concept, (c) presenting a trial to test understanding or performance, (d) providing feedback, and (e) branching to a remedial sequence if necessary or moving the learner ahead to the next level of instruction. These steps may be generalized into the three stages of stimulus, response, and feedback.

The stimulus may be a problem, text, situation, or question (Caldwell, 1982). It is necessary for the stimulus to require a response so that instruction takes on the nature of interactivity. Prompts can be used to promote correct responses. The three types of prompts described by Caldwell (1982) are verbal (using key words to provide cues), thematic (introducing a theme which cues the student), and visual (providing graphical illustrations to cue the student). Responses should be simple such as "Y" for yes and "N" for no and should not require keyboard competence (Caldwell, 1982; Rybe & Chapman, 1983). Once the student has responded, the computer should provide feedback, reinforcement for correct answers, and additional practice for incorrect responses.

Interactive courseware should maximize student control so that the speed at which the information is presented can be regulated (Ryba & Chapman, 1983). In addition, the student should be given opportunity to set personal goals and to evaluate them. Whenever possible students should be encouraged to verbalize regarding information learned via the computer. This can be encouraged by assigning teams of students to computers and allowing time for discussion (Ryba & Chapman, 1983).

Evaluation Studies

The first commercially developed computer, UNIVAC, made its appearance about 1952, and computers were introduced into the schools in 1965. At that time many teachers compared them to the teaching machines of the 1950's and dismissed them as toys unsuitable for classroom use (Dede, 1983).

Soon after the introduction of computers to educational technology, researchers developed studies to determine whether computers could actually produce expected benefits. Problems with original research were that each evaluation report was published separately and studies were never exact replications of one another in that they "differed in experimental design, setting, and in types of computer applications they investigated" (Kulik, 1983, p. 19).

Research with elementary students during the 1960's usually involved dividing a classroom into two groups with the treatment group participants receiving part of their instruction via computer and the control group being taught by conventional methods (Kulik, 1983). Such research, as reported by Vinsonhaler and Bass (1972), tended to reveal no significant difference in experimental and control subjects when studies compared traditional instruction with CAI or programmed instruction; however, the research indicated that CAI drill and practice was an exception to this rule. This statement was supported in a summary of 10 independent studies of CAI drill and practice which included over 30 separate experiments with about 10,000 subjects. An analysis of these studies indicated

> substantial advantage for CAI augmentation of traditional classroom instruction, where standardized achievement tests are used as the criteria for educational performance. Generally CAI groups show performance gains of one to eight months over groups receiving traditional instruction. (p. 29)

Evaluation studies of CAI can be categorized into two groups. First, there were large-scale evaluations of major projects such as PLATO (Programmed Logic for Automated Teaching), TICCIT (Time Shared Interactive Computer Controlled Information Television), and the remedial drill and practice materials of the Computer Curriculum Corporation. PLATO and TICCIT were major projects funded by the National Science Foundation beginning in 1971. Secondly, there were the shorter, less extensive studies of other efforts (Bunderson & Faust, 1976); Grayson, 1981).

PLATO utilizes a large computer to support 400 to 500 terminals which are distributed throughout the country and connected by telephone lines. Programs are stored centrally and delivered to the remote sites when needed. Control Data Corporation, which now markets PLATO, has made it available from about 130 centers throughout the country to minimize communication costs. A large-scale evaluation of the PLATO system by Educational Testing Service found that there was no significant difference in student achievement or in attrition rates between PLATO and conventional classes but that both students and teachers liked the idea of using PLATO (Grayson, 1981).

TICCIT uses stand alone mini-computers to serve terminals that incorporate standard television sets, with the courses developed by teams of instructional developers. After Educational Testing Service evaluated the effectiveness of three courses developed

> at a cost of almost $1.9 million each in three post-secondary institutions, it found that TICCIT-taught students scored on the average five percent higher on final examinations but had markedly lower completion rates and felt more ignored as individuals than students in teacher-led courses. (Grayson, 1981, p. 10)

Kulik, Kulik, and Cohen (1980) reviewed the results of 59 studies of computer-based education using meta-analysis techniques and found that, at the college level, the computer made "a small but significant contribution to the effectiveness of the teaching of students of all aptitude levels" (p. 538). Examination scores were raised by 1/4 of a standard deviation. In addition, CAI had a small but "positive effect on the attitudes of students toward the instruction they received and toward the subject matter" (p. 538).

A study evaluating the effects and effectiveness of CAI conducted at the University of Leeds, England, examined teachers' assessments of current educational programs, the decisions which guided their application in the classroom, the influence of these materials on learning activities, and what teachers themselves learned from the experience. For this study, 91 CAI programs were obtained from publishers and other sources. Subject areas included mathematics, science, geography, and economics. Students from four schools were the principal participants in the study. Overall, the project showed that the initial interest in CAI could wane if not secured through relevant program/curriculum developments and appropriate training. One phase of this study in mathematics resulted in posttest results which favored the CAI groups but the findings were not statistically significant.

Programs were restricted in design and application to follow normal teaching methods and worksheets, factors influencing the low gains. Overall, teachers judged the experiment to be successful and considered opportunities provided by the programs for staff to monitor and question pupils a significant advantage (Bostrom, Cole, Hartley, Lovel, & Tait, 1982).

Evans (1982) reported a study of instructional design of computer-based educational systems. In this study college psychology majors completed a computer-based course in statistics using instructional units developed to teach concepts within the context of situations to which they are relevant, a technique called problem-oriented instruction. A set of 16 units were developed which began by introducing students to a problem, the solution of which was the topic of the unit. The modules were constructed to guide students through an interactive process toward the problem's solution. Evaluation of the instructional approach revealed that students preferred the computer-based system to workbooks and that a significant improvement occurred in student rate of retention over lecture and workbook-based methods. It was concluded that the improvement in students' problem-solving ability stemmed from the fact that many lessons in the course followed a problem-oriented instruction format.

Computer assisted instruction has been criticized for stifling creativity. Gallini (1983), however, reported that programs which "provide a structure with motivating conditions and classroom activity with involvement, practice, and interaction with teachers and other children seemed to be more successful in the creative training process" (p. 8). Traditional teaching methods often fail to promote creativity because the management of large classes composed of students with many individual differences and the lack of a teaching method to meet diverse needs of pupils make doing so difficult. The one-to-one relationship provided by the computer, however, can overcome some of the limitations presented by the traditional classroom setting when programs are developed skillfully. The elements of a creative environment inherent in CAI are "student self-selection, opportunity to explore new ideas and develop divergent thinking skills, and interaction between tutor and learner" (p. 8).

A tendency for more recent studies to produce stronger results can probably be attributed to the fact that instructional technology has been more appropriately applied in recent years. In a meta-analysis of 51 studies relating to computer assisted instruction, Kulik (1983) reported the following findings:

1. Student learning can be improved with an average effect to raise test scores from the 50th to the 63rd percentile.
2. With computer assisted instruction, student attitudes toward the subject and ratings of quality of instruction are more favorable.
3. Computer assisted instruction results in more positive attitudes toward computers as instructional media.
4. Computer assisted instruction can reduce learning time. Estimates range from 39% to 88%.

A number of studies have reviewed the use of computers for educational purposes, and overall the data appear to be mixed. It was noted that some students liked computers, some learned, others did not learn, and that some school districts appeared to be committed to computers and CAI while others were not. In addition, many authors were cautious when reporting results (Lawton & Gerschner, 1982). Burns and Bozeman (1981) indicated that no ultimate answer relating to the effectiveness or guarantees of CAI success can be presented. Conversely, there were those, such as Bear (1984), who enthusiastically reported that "indications of research point to increased learning using CAI. If used properly, the CAI tool can accelerate learning and improve retention (p. 186).

Teacher and Student Responses

Young people are growing up in a computerized society, while adults are faced with the necessity for adjusting to the new technology. Children are also oriented to the computer in pleasant ways such as playing home computer games or visiting computer arcades, while adults often must cope with frustrations resulting from computer foul-ups. It is no surprise that, when computers are introduced into classrooms, teachers are the ones who feel apprehensive (Quinsaat, 1981). Computer use in education represents a great risk to teachers and makes "incredible demands on education in our capacity for change and our understanding of a teacher's role" (Mathieson, 1982, p. 14).

Holmes (1982) reported that the "second greatest obstacle, after cost, to the implementation of CAI is likely to be teacher acceptance" (p. 9). Reasons cited were poor reward structure for teacher dedication, egocentric concerns, and dehumanization. Educators, according to Holmes (1982), must reward teachers for more than years of service, more in altruistic terms. Fears experienced by teachers include fear of displacement and domination, knowing less than the student, loss of decision-making power and control over the learning experience, equipment failure, and paperwork (Mathieson, 1982). Fear of technology destroying humanity has been with us since time immemorial, and man has "survived all technical advances--the book, the telephone, locomotion, television--and kept his humanity intact" (Holmes, 1982, p. 10).

A more positive stance was indicated by results to a teacher attitude survey conducted by Instructor (Computers? You Bet I'm Interested, 1982) magazine. Of the more than 4,000 readers who responded, 86% expressed a high level of interest in computers. Although few claimed to be above average in computer skills, most (76%) acknowledged some familiarity with microcomputers. Of the teachers familiar with computers, 78% could operate a computer, 67% could do some programming, 47% had selected software for instruction, 39% could help other teachers use computers, and 25% had designed software for classroom instruction. Thirty-nine percent of the respondents said they used computers, and of those who did not, 68% cited lack of access as the reason. Half of the respondents had taken computer courses, mostly at colleges and universities, and 38% had received in-service training.

The big question asked by teachers is whether some teachers will be replaced by computers. Suppes (1980) stated that computers will never replace teachers since the thrust of CAI is to raise the quality of education, not to reduce the cost. Using CAI as an additional educational resource, teachers will continue to deal with students on an individual basis, as well as in group settings, with few changes. Students are expected to participate in computer-related tasks about 20 to 30% of the school day. Just as teachers recognize the importance of books to the learning process, "the day is coming when computers will receive the same recognition. Teachers will look at computers as a new and powerful tool for helping them teach their students more effectively" (Suppes, 1980, p. 235).

Often students do not share the apprehension expressed by teachers. A summary of studies relating to student attitude toward computers compiled by Lawton and Gerschner (1982) which spanned 1976 to 1982 indicated that students in general liked computers. Reasons given were that computers are patient, untiring, calm, give praise and correction, and individualize learning. Other aspects of computer instruction favored by students (Mathieson, 1982) are that computers:

give a sense of control and power
allow active learning
demand interaction
designate the user as the decision-maker
allow the user to begin and end the learning task when ready and motivated
don't get angry

give immediate feedback

provide risk-free simulations

provide a sense of mastery

are friendly, patient, and never give detention

In a study reported by Ryba and Chapman (1983), 50% of the students responded that what they liked best about computers was the element of control since computers allow students to make decisions. For students who have experienced failure repeatedly, the opportunity for control of a learning situation is very important in building self-confidence.

The common perception of the computer freak is a child who is a poor student and unpopular but who has a special gift with computers. He is poorly coordinated, lacks athletic prowess, and wears glasses as he sits pale and wan in front of a computer through late hours. According to White (1982), this is not an accurate description of the situation. Evidence to date suggests that people who excel with computers are also good in allied skills such as mathematics and science. In addition, the process of programming utilizes a certain type of linear thinking not easy for everyone. However, Menis, Snyder, and Ben-Kohav (1980) studied 402 tenth-grade students with low mathematics grades in the ninth grade. They found that after using CAI better mathematics students did not improve their grades on the average, that the weaker students did improve their grades, and that using the computer as a home drill aid raised the self-confidence of the weaker students regarding mathematics.

Low achieving students and those from minority groups "tend to see themselves as dominated by external factors or intervention of people more powerful than themselves" (Ryba & Chapman, 1983, p. 49). This theory of learned helplessness explains to some extent student achievement in response to CAI. Crandall (1982) believed CAI could be used to help these pupils perceive a causal relationship between their own actions and the feedback that occurs. While the computer itself generates a large measure of control over the learning situation, individuals tend to perceive themselves as being in charge to a greater degree than is customary in a traditional setting. Further, it would seem that the impersonal nature of CAI could promote high levels of independence or self-management of learning, and when students "become internally controlled, they are more likely to make gains in mathematics and reading skill" (Ryba & Chapman, 1983, p. 49).

Dover (1983) indicated that the brightest student may be the one most receptive to the use of computers for teaching.

> In any case, when viewed in terms of previous attempts to provide for the educational needs of the gifted and talented, the computer represents a major breakthrough. At the lower levels of the computer spectrum, gifted students have access to instant advanced instruction through complex multi-level branching programs. At higher levels, via simulations and programming, they gain access to phenomenon otherwise outside their realm of experience but not beyond their level of ability. (Dover, 1983, p. 81)

Conversely, there are others who believe that "it is not necessarily the most academically successful child who is more skillful with the computer" (Overall, Howley, & Leventhal, 1981, p. 37). In systematic observations of computers use by slow learning high school students, Ryba and Chapman (1983) found that an average of 94% of the students' time was spent actively attending or problem solving. In addition, those students frequently made self-commentaries concerning their interactions with the computer (14% of the time). Research reported by Brown (1975) indicated that overt verbalization can significantly enhance the performance of slow learners. In summary, results of CAI utilization with varying ranges of intellect, from gifted to slow learners, appeared to be mixed.

Hoffman and Waters (1982) found that CAI produced better results with those who can "quietly concentrate, are able to pay attention to details, have an affinity for memorizing facts, and can stay with a single task until completion" (p. 21). Pritchard (1982) suggested that use of computers for instruction requires a learning style which includes (a) keyboard dexterity, (b) attention to detail, (c) aptitude for visual learning, (d) ability to sit still, (e) preference for working alone, and (f) intuitive and diagnostic abilities.

Home Economics Utilization

A search of the literature revealed very little activity related to application of computer technology to home economics education at the secondary level. Since computers have the "potential to be the next major home appliance" (Hausafus, 1983, p.32b), they have implications for home economics at a variety of levels: home, school, and university.

A survey of computer use in one high school (Grossnickle, Laird, Cutter, & Tefft, 1982) indicated that a relatively small percentage of faculty used computers for teaching or administrative purposes. Departments of English, Foreign Language, Social Science, Art, Special Education, Music, Physical Education, and Home Economics did not have a single teacher using microcomputers. It seemed that computer utilization was "supported by those whose counterparts in the outside world have 'traditionally' been associated with computers, that is, Science, Mathematics, Business, and Industrial Arts teachers" (p. 18).

Indications are that universities are assuming a leadership role in using computers for teaching home economics. Students in the College of Home Economics at Iowa State University are offered a variety of opportunities to use computers and to become familiar with their applications. Software programs have been developed in each department of the College of Home Economics, and the graphics capabilities of computers are used in kitchen design courses and clothing construction training. In an introductory course, students work with a faculty-developed software package called EDITHE which simulated the decisions a home economics teacher may make when beginning to teach in a new community (Hausafus & Ralston, 1983).

The University of Nebraska has used a combination of programmed instruction and CAI to supplement teaching of a textiles course. For this exercise, students read a booklet of programmed instruction and then go to the computer for a series of either fill-in-the-blank or multiple-choice questions. Lessons available include those on topics of textile terminology, years, simple and plain weaves, care, labeling, textile legislation, and flammability legislation. Student exposure to computer technolgy is an added advantage for merchandising/retailing majors since computers will be utilized in their professional careers after graduation (Kean & Laughlin, 1981).

In summary, the fact that education is in the second phase of a computer revolution has been well documented in the literature; however, the application of this technology to the teaching of home economics has not been well documented. Since computers are expected to be in the home as well as in the workplace, it follows that home economics students need to become familiar with computer capabilities. One method for providing this exposure for students is by using computers for CAI. This study, developing and field testing a CAI program, is intended to contribute toward promoting computer utilization in the field of home economics.

CHAPTER III

METHODS AND PROCEDURES

Utilization of microcomputers to supplement teaching is a timely topic and one which has many proponents and a number of skeptics. Issues usually addressed relate to whether learning takes place in a student/computer encounter, and if so, what factors affect the amount of material learned. The purposes of this study were to develop and field test microcomputer software, to determine whether students learned more using the software than from reading similar material, and to examine relationships between amount of information learned and several factors thought to affect learning. These factors included IQ, grade point average, computer familiarity, and student attitude toward computers.

This chapter provides an accounting of the experimental design of the study, site and sample selection, development of instructional materials, instrumentation, data collection, treatment administration, and data analysis.

Experimental Design

The study was experimental in nature, including development of two educational tools, comparing their effectiveness, and examining factors contributing to variability of gain scores for the experimental group. A sample of

70 students divided into experimental and control groups was drawn from a population of girls and boys enrolled in at least one home economics course in a high school. Prior to the experimental phase of the study, both groups completed a pretest, and the experimental group completed attitude and familiarity questionnaires. The experimental group participated in CAI sessions individually, separated from others, but during the home economics class time. Control group participants were excused from class laboratory activities to complete the reading assignment. On the day following treatment, participants took a posttest, and 1 week later, the second posttest was administered. Identical questions comprised all three tests.

Site Selection

In searching for an appropriate site for this study, the researcher contacted the vocational supervisor of a county school system in Southeastern North Carolina as a preliminary step to locating a school. After a telephone conversation, the vocational supervisor requested that a letter stating purposes of the study and research requirements be written for presentation to administrative heads of the school system (Appendix A). Permission to proceed was forthcoming, and a specific school was selected. Soon a contact was made with the principal, who in turn referred the researcher to his assistant. Then, a meeting with the three home economics teachers and the assistant principal was scheduled, and at that time the study was described to the group. When presented options of topics relating to home management/family economics, teachers chose consumer credit as a subject inherent in all courses and one which could be scheduled without disrupting course sequence. Teachers were requested not to teach this topic until after completion of the study. A tentative date for conducting the experiment was set.

Sample Selection

Subjects for this study were selected from 10th, 11th, and 12th graders enrolled in at least one home economics course in the high school. Home economics course offerings included Housing, Adult Roles, Food Service, Food Preparation, Clothing, and Clothing Service.

Prior to selection of the sample, both computer program and reading material were demonstrated to the three teachers participating in the study. At that time they were asked to exclude from the population of students anyone who could not read well enough to understand the material without coaching. The 138 students who qualified for the study were assigned numbers by their teachers, and 35 for each group were selected by the researcher using a table of random numbers. Teachers were then notified of the numbers selected for inclusion in the study. Since student names were to remain anonymous, their numbers were used for identification, and teachers retained master lists of pupils and their corresponding numbers.

Development of Instructional Materials

Learner objectives for both methods of instruction (supervised reading and computer assisted instruction) were as follows:

1. To define credit.
2. To recognize examples of sales and cash credit.
3. To recognize relationship between terms of repayment and cost of credit.
4. To apply the 3 C's of credit (character, capacity, and collateral) to given situations.
5. To distinguish between installment and noninstallment credit.
6. To recognize definitions of terms related to credit.

The computer program "Consumer Credit" was written in AtariBASIC computer for an Atari BOOXL, 64k microcomputer. Both of the modules included color, sound, inverse video, and simple graphics. It was pilot tested by a group of high school students whose suggestions were incorporated into the final version. The first module included introductory material, instructions for keying in and erasing answers, and basic information about consumer credit. Divided into topics, it presented a small amount of information and then allowed students to type answers to questions. Each topic was concluded with a "credit check" consisting of simple case study questions which required students to apply facts just learned by inputting answers. The computer gave immediate feedback by reinforcing right answers and correcting wrong ones.

The second module was drill and practice in a game format. In the beginning students were instructed that they would be given 10 questions with two chances to get right answers. Questions were multiple choice, with answers listed across the bottom of the screen. Ten points were awarded for first answers which were correct and 5 points for second answers which were correct. After the second incorrect response, the computer gave the correct answer. At the end of the module student scores were revealed, and an opportunity to repeat the exercise was offered to those with scores below 80. Consequently, students were allowed to repeat the module as many times as they wished. Although keyboard competence was not required, typing skill was helpful in reducing tension since students were required to type answers to questions.

The materials for the supervised reading unit covered the same content as the computer program and was pilot tested by a class of home economics students. It was made up of three modules entitled "Understanding Credit," "Securing Credit," and "Cost of Credit." Each module started with "Points to Remember" and ended with case study questions, answers to which were located in a key on the last page (Appendix C). Students were instructed to check their answers to one module before going on to the next module.

Instrumentation

Five instruments were designed by the researcher for this study. The first, "Student Data Sheet," was completed by teachers and contained student numbers, grade point averages, IQ scores, grade levels, and home economics courses. The second, "Student Activity Checksheet," was used by teachers and the researcher to keep records of student participation in the study. It included completion dates for worksheets, questionnaires, treatment, and tests (Appendix B). A third instrument was the test which was used as a pretest, a posttest, and a second posttest. It included 17 multiple-choice, short-answer, and matching questions which were based on unit objectives (Appendix B). Each question was assigned a value of 1 for a total of 17 points.

The remaining two instruments were used with the experimental group exclusively. They were both pilot tested with home economics students in a school other than the one chosen for the study. The "Computer Attitude Questionnaire" was used to assess the students' attitudes toward computers, using a Likert-type scale with a series of 10 attitude statements either clearly favorable or clearly unfavorable. The response alternatives were "Strongly Agree," "Agree," "Undecided," "Disagree," and "Strongly Disagree." Responses were scored by assigning them 1 to 5 points for negative statements and 5 to 1 points for positive statements. Then scores were calculated by summing each student's score on all questions and dividing by the number answered. Thus, a high score indicated positive attitudes toward computers, while a low score meant attitudes toward computers were relatively more negative.

A "Computer Familiarity Questionnaire" was used to determine the degree of familiarity and past experience students possessed relative to computers. It included a series of seven questions pertaining to frequency with which microcomputers were used and video games were played. The response alternatives were "Never or Hardly Ever," "Seldom" (once a month or less), "Sometimes" (2 or 3 times a month), "A Lot" (about once a week), and "All the Time" (more than once a week). Responses were scored by assigning values ranging from 1 for "Never or Hardly Ever" to 5 for "All the Time." Then scores were calculated by summing each student's score on all questions and dividing by the number answered so that a high score indicated greater familiarity and a low score indicated less familiarity with computers.

Data Collection

During the calendar week prior to implementation of the study, teachers were notified of the students (referred to by number) randomly selected for inclusion in the study.

They then partially completed Student Data Sheets and forwarded them to the school guidance counselor, along with the master list of student names and corresponding study numbers for IQ scores and Grade Point Averages. During this time participating students were asked to take the pretest and students in the experimental group completed familiarity and attitude questionnaires. All students took posttests on the day after completing the treatment (CAI or reading), and 1 week later took the second posttest.

Treatment Administration

Since 70 students from 12 classes participated in the study, there were some students in the sample who were scheduled for home economics during each of the seven class periods which comprised the school day. This factor was helpful in distributing the testing throughout the several days of the study, especially since experimental group students worked individually with the one computer assigned to the study.

Both groups were given verbal instructions, including the fact that questions to clarify instructions would be answered but no discussion allowed. There were no time limits set on either group; and in cases where the class period ended before students completed their work, they were allowed to continue on the following day. Students were excused from laboratory activities of home economics classes to participate. Control group participants remained in the classrooms to read the material, but experimental group participants were sent individually to an office where the computer was set up. Before beginning the CAI, the computer was explained and the students allowed to practice typing and deleting their names. Also explained was the fact that the researcher would be available nearby for questions or to assist with the computer should problems arise.

Data Analysis

Descriptive statistics such as frequency distributions, percentages, and means were used to describe factors related to characteristics of the sample, answers to pretest, post-test, and second posttest questions, and gain scores. One-way analysis of variance was calculated on the mean gain scores of treatment group versus control group. Multiple regression was used to study the effects of the variables, grade point average, IQ, computer familiarity, and attitude toward computers, on the amount of learning achieved by the experimental group.

CHAPTER IV

RESULTS AND DISCUSSION

The major purposes of this study were to investigate a computer application in a secondary school setting, to develop and field test microcomputer software with high school home economics students, and to determine whether students learned more from computer assisted instruction than from reading similar material. In addition, the study examined the effects of intelligence, grade point average, computer familiarity, and interest in computers on the amount of information learned from studying via computer. This chapter presents and discusses the results of the study.

Description of the Sample

Of the 70 subjects selected for the study, 2 were eliminated because of absenteeism, resulting in 35 participants in the experimental group and 33 participants in the control group. Of the 68 subjects, 22.1% were sophomores, 29.4% were juniors, and 48.5% were seniors in their last semester of study. Their grade point averages ranged from 67 to 92, with the largest proportion (45.6%) being in the 77 to 84 range, which was classified as "C" on the school's grading scale. IQ scores of students ranged from 60 to 121, with a median of 85.5 and a mean of 85.3. Approximately 59% of the group had IQ scores below 90, and about 40% of the scores were in the average range of 90 to 110 (Table 1).

Random selection resulted in grade point averages of the two groups being similar. The mean grade point average of the experimental group was 80.24, while the mean grade point average for the control group was 79.14. The mean IQ for the experimental group was 88.3, and for the control group, 82.2.

The experimental group consisted of a larger proportion of seniors (60%) compared to 36% seniors in the control group. Representation of juniors was approximately equal at 29% for the experimental group and 30% for the control group. Only 11% of the subjects in the experimental group were sophomores, while 33% of the control group were sophomores.

Descriptive Analysis of Student Attitudes

Students in the experimental group responded to 10 items on the computer attitudes questionnaire using a Likert-type scale with response categories ranging from "strongly agree" to "strongly disagree." Items were stated positively and negatively, and over 70% of the subjects either "strongly agreed" or "agreed" with five of the items on the questionnaire (Table 2).

Responses indicated that students strongly agreed or agreed that computers are useful (91.4%), that knowing

Table 1

Grade Point Averages and IQ Scores of Subjects

Range	Number	Percentage
	Grade Point Averages	
93-100 (A)	0	0
85-92 (B)	13	19.1
77-84 (C)	31	45.6
70-76 (D)	23	33.8
Below 70 (failing)	1	1.5
	IQ Scores	
Above 110	1	1.5
100-109	6	8.8
90-99	21	30.9
80-89	18	26.4
70-79	11	16.2
60-69	11	16.2

Table 2

Responses to Computer Attitude Questionnaire for Experimental Group

Questions	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
(+) 1. Computers are useful in today's society.	54.3	37.1	8.6	0	0
(-) 2. Using computers is a boring activity.	8.6	8.6	11.4	48.6	22.9
(+) 3. Knowing about computers will help me find a job after I finish high school.	40.0	45.7	8.6	5.7	0
(+) 4. Computer games are exciting.	25.7	54.3	14.3	2.9	2.9
(-) 5. Learning to use a comter is too complicated.	14.3	8.6	34.3	34.3	8.6
(+) 6. There is no need to be afraid of damaging computers.	2.9	20.0	20.0	40.0	17.1
(-) 7. I prefer TV to playing computer games.	11.4	11.4	37.1	34.3	5.7
(-) 8. Thinking about using a computer makes me nervous.	8.6	17.1	8.6	45.7	20.0
(+) 9. Teens who write computer programs are to be envied.	5.7	45.7	14.3	17.1	17.1
(-) 10. Computers cannot be used as a teaching tool.	14.3	5.7	8.6	37.1	34.3

Note. n = 35
(+) and (-) indicate positive or negative statements for scoring purposes. Numbers represent percentages.

about computers can be helpful when seeking employment (85.7%), that computer games are exciting (80.0%), that using computers is not boring (71.5%), and that computers can be used for teaching (71.4%). The item relating to teens who can write computer programs being envied (Item 9) elicited the greatest variability in answers with 51.4% of the responses either "strongly agree" or "agree," 14.3% "undecided," and 34.2% either "disagree" or "strongly disagree." Topics which rated highest on "undecided" were preference for television over computer games (37%) and learning to use computers being complicated (34.4%). In general, students tended to agree with positively worded statements and disagree with negatively worded statements, which overall indicated positive attitudes toward computers.

Descriptive Analysis of Computer Familiarity Questionnaire

Results of the Computer Familiarity Questionnaire indicated that most students in the experimental group did not use computers at home or school to any great extent. Over 70% indicated that they played with computers at home either "never/hardly ever" or "seldom" and approximately 94% indicated that they used computers for assignments either "never/hardly ever" or "seldom." Use of computers at school was also infrequent, with over 77% of the students indicating that they used computers at school for schoolwork either "never/hardly ever" or "seldom." However, 31.3% of the respondents played computer/arcade games in an arcade or other public place either "a lot" or "all the time" and 31.4% played games "sometimes" (Table 3). Another 20% played at home "a lot" or "all the time." Indications were that usage for game-playing purposes by these students was more frequent than use of computers for educational purposes.

Test of Hypotheses

Two hypotheses were tested in this study. The data and statistical analyses used to determine their acceptance or rejection are presented in this section.

Hypothesis 1: There is no difference in mean gain scores on a test on consumer credit between the treatment group instructed by a microcomputer program and the control group who read similar material.

The data used as evidence to test the first hypothesis were three gain scores: Gain 1 (posttest minus pretest), Gain 2 (second posttest minus posttest), and Gain 3 (second posttest minus pretest). A frequency distribution of gain scores of both control and experimental groups is shown in Table 4.

The analysis of variance technique was used to determine statistical significance of differences in mean gain scores (Table 5). Gain 1 scores for the experimental and control groups, with an F-value of 30.41, and Gain 3, with an F-value of 19.33, were statistically significant, indicating that

Table 3

Responses to Computer Familiarity Questionnaire for Experimental Group

Activity	Never/Hardly Ever	Seldom	Sometimes	A Lot	All the Time
Play games/public	22.9	14.3	31.4	25.7	5.6
Play/home	45.7	25.7	8.6	11.4	8.6
Work/school	68.6	8.6	11.4	5.7	5.7
Watch/school	54.3	22.9	8.6	0	14.3
Assignments/home	88.6	5.7	2.9	0	2.9
Education/home	74.3	8.6	14.3	2.9	0
Other 68.6	68.6	11.4	8.6	5.7	5.7

Note. Numbers represent percentages.

Table 4

Frequency Distribution of Gain Scores for

Consumer Credit Test

Variable	Value Range	Frequency Experimental	Frequency Control	Percentage Experimental	Percentage Control
Gain 1 (Posttest 1-Pretest)	-10 to -6	0	5	0	15.2
	-5 to -1	2	13	5.7	39.4
	0	5	3	14.3	9.1
	1 to 4	16	9	45.7	27.3
	5 to 9	11	3	31.4	9.1
	10+	1	0	2.9	0
Gain 2 (Posttest 2-Posttest 1)	-10 to -6	4	0	11.4	0
	-5 to -1	3	8	8.6	24.2
	0	10	14	28.6	42.4
	1 to 4	16	10	45.7	30.3
	5 to 9	2	0	5.7	0
	10+	0	1	0	3.0
Gain 3 (Posttest 2-Pretest)	-10 to -6	1	3	2.9	9.1
	-5 to -1	4	12	11.4	36.4
	0	1	6	2.9	18.2
	1 to 4	16	9	45.7	27.3
	5 to 9	11	3	31.4	9.1
	10+	2	0	5.7	0

Note. Experimental group n = 35
Control group n = 33

Table 5

Analysis of Variance for Pretest and Posttest Gain Scores

Variables	Source	df	*F*-value	*F* Probability
Gain 1	Posttest 1/Pretest	67	30.41	.00
Gain 2	Posttest 1/Posttest 2	67	0.71	.40
Gain 3	Posttest 2/Pretest	67	19.33	.00

students studying via microcomputer did learn more than those who studied by reading during the time periods between the pretest and the two posttests, respectively. The mean score for Gain 1 for the experimental group during this period was 3.63, and for the control group, -1, whereas the mean score for Gain 3 for the experimental group was 3.54, and for the control group, -.39 (Table 6). Gain 2, with an F-value of .7175, was not statistically significant at the .05 level, indicating that any gain in scores between the first and second posttests could be attributed to chance. Therefore, Hypothesis 1 was rejected for Gain 1 and Gain 3.

Hypothesis 2: Neither IQ, grade point average, computer familiarity, nor attitude toward computers affect the amount of information learned by students who complete a unit on consumer credit taught via microcomputer.

The data used as evidence to test this hypothesis were IQ scores and grade point averages secured from school records and scores computed from familiarity and attitude scales on questionnaires completed by the experimental group. Table 7 presents the results of three stepwise multiple regression analyses utilizing the three dependent variables measuring gain scores and four selected independent variables. None of the factors was statistically significant; therefore, H2 was not rejected. None of the four explanatory variables (IQ, grade point average, attitude toward

Table 6

Mean Gain Scores of Experimental and Control Groups

Variables	Source	Experimental	Control
Gain 1	Posttest 1/Pretest	3.63	-1.00
Gain 2	Posttest 1/Posttest 2	0.00	0.61
Gain 3	Posttest 2/Pretest	3.54	0.39

Table 7

Results of Stepwise Multiple Regression Analysis

Variable	b	Beta	Std. Err.	t
		Gain 1		
Familiarity	.05	.08	.13	.42
GPA	-.06	-.10	.12	.45
Attitude	-.11	-.16	.13	.81
IQ	.08	.34	.06	1.48
Constant	3.88			
R^2 = .08		F = .64	SE_{est} = 3.06	
R^2_{adj} = .04		CV = 2.29		
		Gain 2		
Familiarity	.14	.19	.14	.97
GPA	.10	.15	.14	.73
Attitude	.05	-.07	. 4	-1.36
IQ	-.08	.30	.06	-.06
Constant	-.65			
R^2 = .12		F = .99	SE_{est} = 3.41	
R^2_{adj} = -.00		CV = 11.61		
		Gain 3		
Familiarity	.19	.23	.16	1.17
GPA	.05	.06	.16	.29
Attitude	-.16	-.19	.17	-.96
IQ	-.00	-.19	.17	-.96
Constant	3.23			
R^2 =.06197		F = .50	SE_{est} = 3.92	
R^2_{adj} = -.06		CV = 2.40		

computers, and familiarity with computers) was a significant predictor of how much learning occurred in the experimental group.

The R^2 of .08 for Gain 1 indicated that approximately 8% of the variability in gain scores was explained by the set of independent variables chosen. The adjusted R^2 of .04 indicated that, after adjusting for the number of independent variables, about 4% of the variability in gain scores of students being taught by CAI was explained.

The standard error of the estimate of 3.06 indicated that the "average" error in predicting gain scores would be about plus or minus three points. The coefficient of variability of 2.29 indicated that the standard error of the estimate relative to the mean gain score for Gain 1 was very large. Thus, the derived equations is not capable of accurately predicting gain scores of students in the period between the pretest and the first posttest.

For Gain 2, a time during which there was neither treatment nor stimuli, the R^2 of .12 indicated that approximately 12% of the variability in gain scores was explained by the four independent variables chosen, but an adjusted R^2 of -.00 indicated that, after adjusting for the number of independent variables, none of the variability was explained. Similar results for the prediction ability of this equation were found as for the first analysis.

The R^2 of .06 on Gain 3 indicated that the four variables explained approximately 6% of the variability in gain scores representing the period from pretest to the second posttest. The adjusted R^2 for this period was -.06. The standard error of the estimate and the coefficient of variability were again indicators of the poor prediction ability of this equation.

The four independent variables selected as possible explanatory factors were not generally very successful at explaining the variability in learning over any of the three time periods. Possible reasons for this lack of success will be explored in the discussion section.

Examination of Test Scores in Relation to Lesson Objectives

The six objectives of the unit on consumer credit which utilized both reading and CAI as methods of instruction were as follows:

1. To define credit.
2. To recognize examples of sales and cash credit.
3. To recognize relationship between terms of repayment and cost of credit.
4. To apply the three C's of credit to given situations.
5. To distinguish between installment and noninstallment credit.
6. To recognize definitions of terms related to credit.

The percentage of correct answers for the questions relating to each objective was computed to determine whether the instructional materials had enabled students to achieve the objectives (Table 8). An examination of pretest scores revealed the percentage of correct answers was lowest for questions relating to cash versus sales credit (Objective 2) and installment versus noninstallment credit (Objective 5). The subject area most familiar to students prior to treatment was the 3 C's of credit; for these questions, 74% of the responses for the experimental group were correct, while 68% of the responses for the control group were correct.

The experimental group achieved a gain in the percentage of correct answers (Gain 1 and Gain 3) for every objective, the greatest gain being in recognizing examples of sales and cash credit and distinguishing between installment and noninstallment credit which increased from 0% to 51% and 10% to 57%, respectively. Since pretest scores in these areas were low, the potential for gain was greater. For other objectives, gains ranged from 9 to 22%, indicating the need to examine these portions of the CAE program. There is the possibility that presenting the information in a different manner or including additional information in these sections could have enhanced the effectiveness of these parts of the program.

The control group, given material to read, experienced decreases in percentage of correct answers for objectives

Table 8

Percentages of Correct Answers for Test Items in Relation to Lesson Objectives

Objective	Experimental Group			Control Group		
	Pre	Post 1	Post 2	Pre	Post 1	Post 2
1. To define credit. (1)	54	77	77	52	30	46
2. To recognize examples of sales and cash credit. (2)	0	59	51	3	14	15
3. To recognize relationship between terms of repayment and cost of credit. (2)	59	73	70	64	58	64
4. To apply 3 C's of credit to given situations. (3)	74	70	83	68	62	65
5. To distinguish between installment and non-installment credit. (2)	10	63	57	12	11	12
6. To recognize definitions of terms related to credit. (7)	62	75	74	60	48	51

Note. ( ) refers to number of questions on the test which relate to that objective.

related to defining credit, applying the 3 C's of credit to given situations, and recognizing terms related to credit from pretest to second posttest. The percentage of correct answers remained constant for questions relating to recognizing the relationship between terms of repayment and the cost of credit (Objective 3) and distinguishing between installment and noninstallment credit (Objective 5). An increase in percentage of correct answers was seen only for questions relating to recognizing examples of sales and cash credit (Objective 2). Indications were that the reading material was not successful in teaching students about consumer credit. Reasons could be the method of reading itself, the organization of the material presented, or that there was no supportive discussion or other activities to assist the student in learning to use this method.

Discussion of Findings

Most of the CAI studies in literature extended over a period of weeks or months and included a series of student sessions with the computer. This study, however, included only one CAI session with unlimited time for completing the two modules which comprised the program. Student participation time for the CAI session ranged from 20 minutes to 70 minutes, with an average of 38 minutes.

Even though this study included a small sample of 68 students (35 in the experimental group and 33 in the control group) utilizing only one instructional method (CAI versus reading), experimental group participants learned a significantly greater amount than did those who read similar material. Thus, the first hypotheses was rejected for the period from pretest to posttest and from pretest to second posttest. The results of this study were consistent with other research findings which supported CAI as an effective method for improving student learning (Bear, 1984; Kulik, 1983).

In this study the control group experienced small negative gain scores from pretest to posttest, indicating that the treatment, rather than increasing knowledge, may have caused students to be confused. The only period during which control group participants did not exhibit a negative gain score was during the posttest to second posttest period, a time when there was no treatment or stimuli. A possible reason for lack of performance on the part of the control group could be that reading unsupported by other instructional methods may be ineffective. In addition, reading probably offered less challenge to students than the computer. The study was conducted during the last month of school, and this also may have contributed to student lack of interest in reading. The instructional material had been evaluated by teachers who eliminated from the population students who could not comprehend it. Reading material was developed at approximately eighth grade level as judged by the Fry Readability Formula (Fry, 1968).

The CAI program developed by the researcher could be compared to one written by a teacher who had limited programming ability. Even though the program was definitely amateurish, it was successful in promoting student learning for a sample of "average" students, since more than 80% of the students in the study had grade point averages at the "C" level or below. One approach to reducing the cost of software is to train teachers to write programming code. Tanner and Armstrong (1983) reported that the idea does have merit, but such training is costly and writing programs is very time-consuming. Few teachers have sufficient time to devote to writing programs. Based on the experience of developing a program for this study, it is believed that some training for teachers, enough to edit programs, would be beneficial since even good courseware needs adapting to individual needs (Daneliuk & Wright, 1981).

White (1983) reported that drill and practice was effective because it improved motivation and attention. The second module of the CAI unit in this study was drill and practice. The fact that answers on the CAI program had to be typed required increased concentration, a factor which may have contributed to better performance by the experimental group on test questions for which there were no prompts; namely, short-answer items.

The instrument used for pretest, posttest, and second posttest included 17 questions: 5 multiple choice, 4 short answer, and 8 matching. The types of questions used, with the exception of short answer, provided cues for students. For example, the multiple-choice questions, with three choices, gave students a 33.3% chance of obtaining correct answers whether the material was known or not. For matching and multiple-choice items, students had only to recognize answers. Short-answer items had no cues, however, and students were required to recall answers. The experimental group made the highest gains in percentage of correct answers on the four questions which were short answer. On the pair of questions relating to sales credit versus cash credit, the experimental group realized a gain of 51% correct answers from the initial pretest to the second posttest, while the control group realized a 12% gain in correct answers during the same period. The same was true for the two questions relating to installment credit versus noninstallment credit, for which the experimental group realized a 47% increase in correct answers from the pretest to the second posttest, compared to zero percentage gain for the control group during the same time period. Again, it is believed that the drill and practice format and the requirement for typing answers provided practice for students which enabled them to remember the information.

Results of a study by Kee (1981) indicated that students with more computer experience preferred more sophisticated programs and games with a goal. White (1983) reported on studies which changed software, characteristic by characteristic, to determine which aspect was most appealing to students. Results showed that "the idea of a challenge, the involvement of fantasy, and the game format" (White, 1983, p. 14) were most appealing to participants. Since students participating in this study did not indicate a high level of familiarity with computers as measured by that questionnaire, their reaction to the drill and practice in game format as observed by the researcher was positive. The second module of the CAI program allowed students to repeat the activity as many times as they wished, with a goal of increasing the final score. Several students subsequently took advantage of this opportunity, and one student repeated it four times in order to raise his score to 100.

The second hypothesis dealt with the effects of variables IQ, grade point average, attitude toward computers, and familiarity with computers on mean gain scores. A backward stepwise multiple regression analysis was performed, and neither in the first step nor any of the subsequent steps in the backward elimination process were any of the variables statistically significant in explaining any of the gain scores. In addition, the combination of variables explained only 8% of the variability in Gain 1 (pretest to posttest) scores. Possible reasons were that the instruments used to measure attitude and familiarity were not valid or reliable in that they did not adequately assess student attitudes toward and familiarity with computers in a manner that could be replicated. There could also have been too many variables for the sample size (four variables for 35 subjects), although the backward stepwise process should have dealt with this limitation and revealed any significant variables in later steps if there were any. Variables other than the ones measured for this study could also have been included to tap other dimensions of students' characteristics, such as sex, reading level, achievement in math or science courses, and typing skill.

Results of studies relating intelligence to effectiveness of CAI as a learning medium appear mixed Dover (1983) contended that brighter students may be more receptive to computers. Conversely, Ryba and Chapman (1983) reported that CAI promotes concentration for slow learners. In this study, intelligence was one of the factors which was not statistically significant in affecting gain scores. A possible explanation for this could be that IQ scores of 98% of the subjects were either average (90-110) or below average (below 90) with an inadequate representation of people with higher levels of intelligence.

Ryba and Chapman (1983) reported that students talked to themselves (or the computer) during CAI sessions as they did in this study. Comments were "Oh," "I can't believe I missed that one," and "This is great!" Ryba and Chapman also found that the computer was effective at holding the attention of the student in that 91% of the time spent at the computer was spent attending to the computer or problem solving. During this study the researcher also noticed that students relaxed after a few minutes and seemed oblivious to their surroundings. Most students maintained eye contact with the computer screen even while talking to the researcher.

This study supported other research which indicated that CAI has potential for increasing student learning when used with software suitable for the student and the topic being taught. It is the opinion of the researcher that, as students become more familiar with this learning medium, more sophisticated programs will be required. One thing appears certain: technology is advancing very rapidly, and educators are faced with a tremendous responsibility to utilize it to facilitate learning.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

The purposes of this study were to develop a microcomputer program for use with high school students, to determine whether such students learned more using the software than from reading similar material, and to examine relationships between amount of information learned and selected variables.

Summary

Specific objectives of the study were (a) to develop and field test microcomputer software on consumer credit, (b) to determine whether students taught by computer exhibit a greater increase in gain scores on a consumer credit test than those who read similar material, and (c) to examine relationships between amount learned and grade point average, IQ, computer familiarity, and student attitude toward computers.

Two null hypotheses were tested in the study:

H_1: There is no difference in mean gain scores on a test on consumer credit between the treatment group instructed by a microcomputer program and the control group who read similar material.

H_2: Neither IQ, grade point average, computer familiarity, nor attitude toward computers affect the amount of information learned by students who complete a unit on consumer credit taught via microcomputer.

Five instruments were developed by the researcher for use in this study. They included two forms for use by teachers for recordkeeping purposes. In addition, a 17-item knowledge test was designed for use as a pretest, posttest, and second posttest. The remaining two instruments were questionnaires completed by experimental group participants to determine attitude of students toward computers and level of familiarity with computers.

Consumer credit was the topic chosen for the instructional materials developed. Learner objectives for both methods of instruction (supervised reading and CAI) were the following: (a) to define credit, (b) to recognize examples of sales and cash credit, (c) to recognize relationship between terms of repayment and cost of credit, (d) to apply the 3 C's of credit (character, capacity, and collateral) to given situations, (e) to distinguish between installment and noninstallment credit, and (f) to recognize definitions of terms related to credit.

The CAI unit, written in AtariBASIC language for an Atari 800XL microcomputer, consisted of two modules. The initial module was dialogue, first presenting material and then allowing students to answer questions followed by "credit checks" which presented case study questions. Students were required to type answers and were given immediate feedback as to accuracy of answers. The second module was drill and practice in a game format. In the beginning students were instructed that 10 questions would be presented and there would be two chances to get right answers. Questions were multiple choice with answers listed horizontally across the bottom portion of the screen. Ten points were awarded for first answers which were correct and 5 points for second answers which were correct. After the second incorrect response, the computer gave the correct answer. At the end of the module student scores were revealed, and an opportunity to repeat the exercise was offered to those with scores below 80. The reading unit covered the same material as the computer program including three parts entitled "Understanding Credit," "Securing Credit," and "Cost of Credit." Each part started with "Points to Remember" and ended with case study questions, answers to which were located in a key on the last page of the lesson.

A sample of 68 10th-, 11th-, and 12th-grade students divided into experimental and control groups was selected randomly from a population of students enrolled in at least one home economics course in a high school. IQ scores of students ranged from 60 to 121, with a median of 85.5 and a mean of 85.3. Approximately 59% of the group had IQ score below 90, and 40% had IQ scores in the average range of 90 to 110. Their grade point averages ranged from 67 to 92, with the largest proportion (45.6%) being in the 77 to 84 range classified as "C" on the school's grading scale.

Descriptive statistics such as frequency distributions, means, and percentages were used to present demographic data and characteristics of the sample related to attitude toward computers and familiarity with computers. One-way analysis of variance was calculated on the mean gain score of treatment group versus control group. Multiple regression was used to study the effects of the variables on the amount of information learned by the experimental group.

Responses by experimental group participants to a computer attitude questionnaire indicated that students "strongly agreed" or "agreed" that computers are useful (91.4%), that knowing about computers can be helpful when seeking employment (85.7%), that computer games are exciting (80.0%), that using computers is not boring (71.5%), and that computers can be used for teaching (71.4%).

Results of the questionnaire related to computer familiarity indicated that most students in the experimental group did not use computers at home or school to any great extent, particularly for educational purposes. However, almost one-third played computer games in an arcade or other public place either "a lot" or "all the time" and almost one-third played these games "sometimes."

An analysis of variance was used to test Hypothesis 1. Students taught via microcomputer exhibited a mean gain of 3.63 points from the pretest to the posttest, and the control group realized a 1-point loss in mean gain scores from pretest to posttest. Results of the analysis of variance analysis indicated that Gain 1 (pretest to posttest) and Gain 2 (pretest to second posttest) were statistically significant. Thus, one may conclude that, in this study, CAI taught more information than did reading as measured by test gain scores. Mean gain scores for Gain 2 (posttest to second posttest) were not statistically significant. Hypothesis 1 was rejected for Gain 1 and Gain 3 and was not rejected for Gain 2.

In order to test Hypothesis 2, three stepwise multiple regressions were performed to determine the relationship of the four selected variables (IQ, grade point average, computer familiarity, and attitude toward computers) to gain scores. Results indicated that there were no significant relationships between these four variables and the mean gain scores for the experimental group. Low R^2's and high standard errors of the estimate indicated that these equations and the independent variables measured were not very successful at explaining or predicting the variability in learning by students in the experimental group.

Recommendations for Future Research

As a consequence of the methods used and results reported in this study, some recommendations can be made for future research into the area of computer assisted instruction and its development and effectiveness as follows:

1. In view of the limitations imposed by using only one method of instruction (CAI) compared to only one other method (independent reading), it is recommended that CAI be studied in conjunction with other methods such as lecture, discussion, and reading. Such combinations of methods may show the effectiveness of CAI as a supplementary teaching tool, which is the most likely usage of computers, given hardware and software limitations, in the near future in public schools.

2. Due to the lack of statistical significance of the four variables selected for this study on mean gain scores, it is recommended that other variables be studied to determine factors which affect the amount of information students learn using microcomputers. Possible factors for inclusion in such a study include typing skill, reading level, persistence in going through the program more than once, logical/reasoning ability or something other than IQ tests, and math or science achievement level.

3. Another recommendation is that larger samples be used to study effectiveness of CAI. It is possible that more precise measurement of individual variables used in this study (attitude and familiarity) and tests of these effects with larger samples may result in statistically significant relationships being confirmed. Computer familiarity seems to have particular promise and may show significant effects when there is more variability in this among students.

4. Since questionnaires used in this study possibly lacked validity and reliability, it is recommended that they be revised for further studies and be tested for validity and reliability with an objective of refining them for future use.

5. There is some question regarding whether the test used in this study included enough questions. Therefore, it is suggested that not only more questions be added to the test but a greater variety of questions be included. In addition, an oral test could help determine the level of understanding a student receives from a CAI session.

6. Longer exposure to CAI over a period of months could possibly increase the understanding of the role of computers in education. Possible areas to explore are length of CAI sessions, types of programs preferred by students of varying intellectual levels, spacing of CAI sessions, and changes in student attitudes or personality attributed to exposure to computers over a long period of time.

7. It is recommended that the program developed by the researcher be refined and expanded to provide additional information for students. In addition, speech synthesis would be beneficial in helping students learn correct pronunciation of unfamiliar words.

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APPENDIX A

CORRESPONDENCE

May 26, 1983

Mrs. Peggy Reaves
Vocational Supervisor
Cumberland County Schools
Post Office Box 2357
Fayetteville, North Carolina 28302

Dear Mrs. Reaves:

Computer assisted instruction is a timely issue, and I am interested in writing a set of microcomputer programs related to home economics and field testing them with students in your system as a part of the dissertation requirement for a Ph.D. in Home Economics. Presently, I am enrolled at The University of North Carolina at Greensboro, have completed coursework and preliminary comprehensives, and will be writing my dissertation in the near future.

My plan is to compose a program in Family Resource Management for the Atari 800 XL computer--the specific topic to be decided by teacher(s) and myself. For the experimental part of this project, I plan to determine whether exposure to computer software increased student knowledge by comparing (via analysis of variance) mean gain scores of treatment and control groups. In addition, I would like to study effects of variables such as computer literacy, attitude toward computers, and grade point average or mean gain scores.

To carry out this experiment, I will need a minimum of thirty (one or two classes) home economics students for a treatment group and a similar class for a control group. The control group does not have to be a home economics class but should approximate the treatment group. Both groups would complete a data sheet, a 15-25 question pretest, and a posttest. In addition, the treatment group would require 2-4 class periods to execute the computer programs. The target date is set for spring semester '84 (February or March). I will provide equipment.

What I need at this time is your permission to allow me to carry out this study in the high school of your choice and a commitment from the persons who would be working with me. Hopefully there are a couple of teachers and a principal who would be excited by such a prospect. Please let me hear from you soon.

Sincerely,

(Mrs.) Ann H. Faircloth

APPENDIX B

INSTRUMENTS

Student Number_____

COMPUTER ATTITUDE QUESTIONNAIRE

Please read each sentence and circle the letter under the response that best describes your feeling about that statement. There are no right or wrong answers.

	STRONGLY AGREE	AGREE	UNDECIDED	DISAGREE	STRONGLY DISAGREE
1. Computers are useful in today's society.	A	B	C	D	E
2. Using computers is a boring activity.	A	B	C	D	E
3. Knowing about computers will help me find a job after I finish high school.	A	B	C	D	E
4. Computer games are exciting.	A	B	C	D	E
5. Learning to use a computer is too complicated.	A	B	C	D	E
6. There is no need to be afraid of damaging a computer.	A	B	C	D	E
7. I prefer watching TV to playing computer games.	A	B	C	D	E
8. Thinking about using a computer makes me nervous.	A	B	C	D	E
9. Teens who can write computer programs are to be envied.	A	B	C	D	E
10. Computers cannot be used as a teaching tool.	A	B	C	D	E

Student Number_____

COMPUTER FAMILIARITY QUESTIONNAIRE

Please circle the letter which is true for you.

How frequently do you . . .	NEVER OR HARDLY EVER	SELDOM (once a month or less)	SOMETIMES (2 or 3 times a month)	A LOT (about once a week)	ALL THE TIME (more than once a week)
1. play computer video/arcade games in an arcade or other public place?	A	B	C	D	E
2. play computer video games at home?	A	B	C	D	E
3. learn or work on a computer at school?	A	B	C	D	E
4. watch others work on a computer at school?	A	B	C	D	E
5. use a computer at home for school work (to do assignments or papers, etc.)?	A	B	C	D	E
6. use a computer at home for other things (such as to write programs or play educational games)?	A	B	C	D	E
7 use a computer in any other way? (DESCRIBE HOW YOU USE IT)____________________	A	B	C	D	E

____

____

Student Number______

Date________________

CONSUMER CREDIT TEST

I. Select the correct answers for these statements:

a. Credit worthiness is made up of 3 C's (character, capacity, and collateral) which refer to a person's ability to repay a loan.

Trudy Rogers applies for a $215 loan to buy clothes. She plans to vacation in another state soon and wants to make a good impression while away from home.

Would you classify this information as

______character
______capacity
______collateral

During the school year she earns about $15 a week as a baby sitter.

Would you classify this information as

______character
______capacity
______collateral

She does not own anything to offer in case she cannot make the monthly payments.

Would you classify this information as

______character
______capacity
______collateral

b. Suppose you are buying a 1982 car for $5,000. Since you have only $1,000 for a down payment, you need to borrow the remaining $4,000. Study the following table.

	Interest Rate (APR)	Length of Loan	Monthly Payments	Finance Charge	Total Cost
Creditor A	15%	24 months	$193.00	$ 632	$4,632
Creditor B	15%	30 months	$161.00	$ 830	$4,830
Creditor C	15%	36 months	$139.00	$1,004	$5,004

Monthly payments are lowest for Creditor C because:

______the interest rate is lowest
______the length of the loan is longest
______the amount borrowed is lowest

The finance charge is lowest for Creditor A because:

______the interest rate is highest
______the length of the loan is shortest
______the total cost is least

II. Answer these questions:

a. Consumer credit arrangements can be classified as one of two types. Suppose you want to buy a new "boombox".

If you charge one at an electronics store, what type of credit will you be using?

If you borrow the money from a bank and then pay cash for the "boombox", what type of credit will you use?

b. The types of credit mentioned above can be repaid in two different plans.

If you repay the full amount in one payment, what type of repayment method will you be using?

If you repay in a series of monthly payments for a definite length of time, what method will you be using?

III. Match the following words with their definitions:

____APR	a. amount paid for the privilege of using credit
____Interest	b. the record of how you have paid past debts
____Downpayment	c. annual percentage rate
____Credit	d. past and future ability to repay debt
____Collateral	e. property offered to support a loan and subject to seizure if you do not pay as promised
____Creditor	f. the person or business whom you owe
____Finance charge	g. amount you pay down on an item bought
____Credit worthiness	h. an agency that keeps your credit record
	i. obtaining goods, services, or money now on the promise to pay later
	j. a combination of interest and service charges

CAI PROJECT: CONSUMER CREDIT
Student Data Sheet

Group__________

Student No.	GPA	IQ	Grade Level	Home Economics Course(s)

CAI Project: Consumer Credit
Activity Checksheet
Experimental Group

	Completion Dates					
Student Number	Questionnaire		Pretest	CAI Session	First Posttest	Second Posttest
	Familiarity	Attitude				

CAI Project: Consumer Credit
Activity Checksheet
Control Group

Student Number	Completion Dates			
	Pretest	Reading Material	Posttest 1	Posttest 2

Teacher____________________

APPENDIX C

INSTRUCTIONAL MATERIAL

Consumer Credit

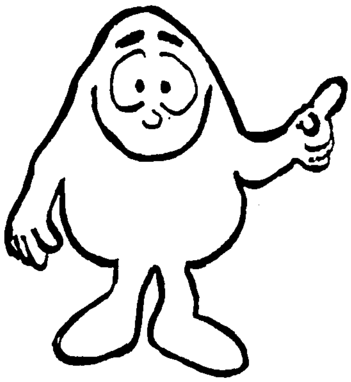
by

Ann H. Faircloth

1984

Instructions to the Student: This unit is a brief overview of consumer credit. Read the information in the order presented. At the end of each section are review questions. After you write in your answers, check them by turning to page 13.

Module 1: Understanding Credit



POINTS TO REMEMBER

- Credit is a way to have goods, services, or money now and pay later
- The two types of credit are cash credit and sales credit
- Credit may be repaid under installment and non-installment plans

A Credit Economy

Credit is an important aspect of our economy. Its use is so widespread that often we take it for granted. Each time we "pay later" we are using credit. A utility bill that allows us 20 days to pay is a form of credit. Monthly billing by newspapers, cable television companies, and telephone companies allows us to use credit. We make trips to the doctor and say, "File for my insurance, and I will pay the balance." We charge furniture, cars, and appliances. We pay mortgage payments on a home. We use credit cards to pay for gas, and we "take out" a loan to pay for education. Uses of credit are many and varied.

Credit enables us to have available goods, services, and money now and pay later. The term "consumer credit" refers to the use of credit by individuals and families (consumers). In addition, consumer credit is used to purchase items which will be used up or consumed. Use of consumer credit enables us to enjoy a higher level of living. The buy now and pay later aspect of consumer credit allows us to use things while we pay for them.

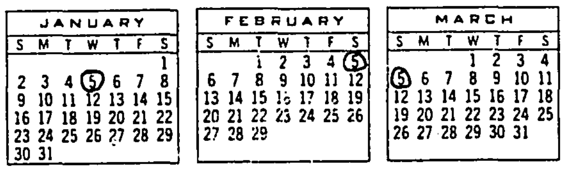
Kinds of Credit

All credit can be divided into these two categories: cash credit and sales credit. Cash credit is extended to persons in the form of money. Usually cash loans are repaid plus finance charges (interest and service charges) and insurance in monthly installments. With some loans, you can repay the full amount in one lump sum payment at the end of the repayment period. In that case, the total amount of the loan plus finance and other charges would be due at that time. When you borrow money, a contract must be signed. Read it carefully. Cash loans are available from banks, savings and loan associations, life insurance companies, credit unions, finance companies, pawnshops, friends and relatives, and loan sharks (heaven forbid!).

Sales credit (also called retail or store credit) is used instead of cash to buy things. When you open a charge account with a department store, get a credit card, or pay for services with credit, you are using sales credit.

Repayment Plans

There are basically two methods for repaying credit: installment plans and non-installment plans. The most popular plan for repaying credit is installment. It is often called buying "on time" and is most often used to purchase large items such as furniture, appliances, televisions and cars. It may be either sales credit or cash credit. Under this plan you finance credit for a specific length of time and make payments every week or month.



Installment contracts have set payments

With installment credit, you:

.. sign a contract

.. agree to make weekly or monthly payments until the debt is paid in full

.. agree to pay finance and service charges

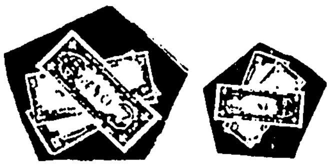
.. use the item or money while paying for it

.. may lose the item you charged or your collateral if payments are not made on time

There are three types of non-installment contracts. The single payment plan is used for cash credit when it is to be repaid at one time. These loans are often made to meet an unexpected need and are paid in 30 days to 12 months. At the end of the loan period, or term, the full payment (the amount you borrowed plus interest) is due.

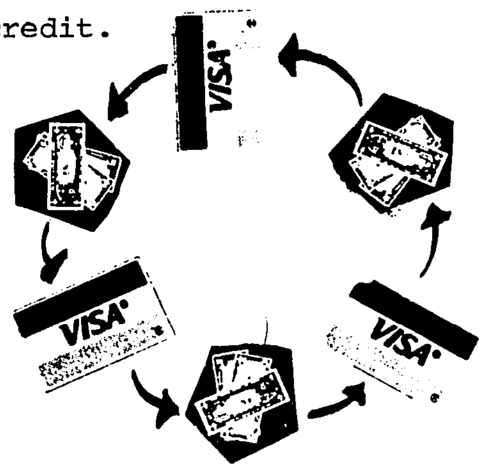
Single payment =
one payment at term

A second type of non-installment contract is the 30-day or regular charge account. Most large stores offer such accounts to their customers. To set up this type of account, you must fill out a credit application and sign a retail credit agreement. Under this arrangement a bill will be sent to you every 30 days. If you pay the full amount at billing, you are not usually charged any interest. But, sometimes you may not be able to pay the full amount, so interest charges are added to the unpaid balance.



30 day accounts charge interest on unpaid balance

A third type of non-installment account is the revolving charge plan. Under this plan, you can charge up to your credit limit and pay a minimum payment each month. It goes in a cycle: you charge, pay, charge some more, and pay some more. The cycle may go on and on if you like. Using a revolving account this way may result in the credit never being completely repaid. Finance charges are added to the unpaid balance each month. Credit cards usually involve revolving credit.



Revolving charge accounts may continue endlessly

LET'S EXAMINE THE ISSUES

For each of these situations, choose the correct type of credit and the repayment plan.

You may look back to pages 2 through 4 if you like.

1. The Atkins family's refrigerator broke down. They charged a new one at Mayboro Furniture and Appliance Company. They will pay the furniture company $59 per month for 18 months.

   Type of Credit: ______Sales
   ______Cash

   Repayment Plan: ______Installment
   ______Non-installment

2. John Fields needed money for a new car. He borrowed $8,000 from the Community Credit Union. The money will be repaid in monthly installments.

   Type of Credit: ______Sales
   ______Cash

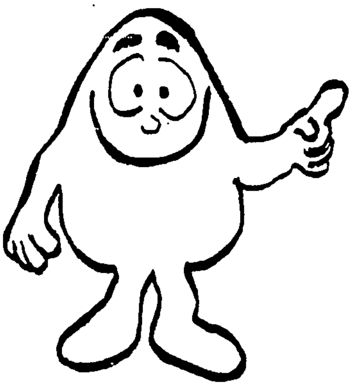
   Repayment Plan: ______Installment
   ______Non-installment

3. Mary Locklear used her charge card to buy a sweater from Belk Department Store. She will pay whatever she can (minimum of $10) each month. Meanwhile, she may buy other things to add to the account.

   Type of Credit: ______Sales
   ______Cash

   Repayment Plan: ______Installment
   ______Non-installment

Compare your answers with those on page 13.



POINTS TO REMEMBER

- since the creditor is taking a risk by offering you credit, he must be reasonably sure your intentions are good
- credit worthiness is determined by character, capacity, and collateral

Shopping for Credit

Possibly you have never used credit, but you probably know others who have. Let's suppose you are planning to buy a stereo system and you don't have enough money to pay cash. When you shop for credit you will find that there are a number of kinds of credit available. There are many interest rates and other charges. Also, you may select from installment and non-installment contracts. You will need to be selective to get the best deal and to insure that you are treated fairly.

Credit Worthiness

Consumer credit is based on faith in the good intentions of the consumer. For that reason, you must meet the requirements of the lender. He judges your ability to repay a loan or make payments on a charge account. Whether you are accepted for credit is determined by your credit worthiness. The three factors considered in determining a person's credit worthiness are character, capacity, and collateral.

Character - refers to your intent to repay the credit. Considered are your honesty, reliability, how well you have paid previous debts, and the intended use of the credit.

Capacity - is your ability to repay. It is judged on your income and the amount of other debts you owe. In other words, your capacity refers to whether you can afford to take on this debt.

Collateral - is property offered to secure a loan. It is something you own which can be taken should you not repay your credit in the terms agreed upon. Creditors want to know what you have that could be used to secure your loan.

Creditors use different combinations of these factors in deciding whether to accept you as a customer. Some set very high standards. Creditors also use different kinds of rating systems. Some rely on their own instinct and experience. Others use a "credit scoring" system to predict whether you are a good credit risk. They assign points to each characteristic and then they rate you on that scale.

A federal law called The Equal Credit Opportunity Act requires that the creditor judge all persons equally in determining credit worthiness.

To build and protect a good credit rating:

be truthful when applying for credit

use credit only in amounts that you can repay safely

fulfill all terms of a credit agreement

pay promptly

consult creditors immediately if you cannot meet payments on schedule

LET'S EXAMINE THE ISSUES

Suppose you are the Loan Officer of Consolidated Bank and Trust Company. Bob Wells and Elsie Barr are applying for loans. You must decide their credit worthiness.

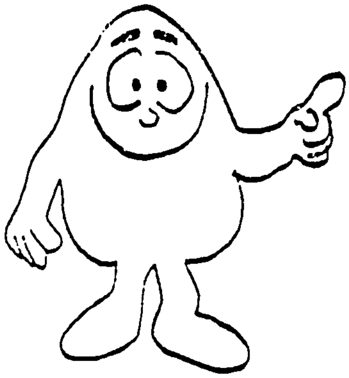
Refer to pages 6 and 7 for descriptions of the 3 C's (character, capacity, and collateral) of credit worthiness.

Answer by placing an "X" in the appropriate block.

	Is this information a part of...		
	CHARACTER	CAPACITY	COLLATERAL
a. Bob would like to borrow \$500 to buy skiing equipment. He owes bills at three stores totalling \$300. These amounts are overdue but he says he made payments on all three last month and will do so again this month.			
b. His income is hardly enough to pay his debts. He expects to lose his job in 2 months.			
c. Elsie wants a loan for a new car. She has a good record of paying her debts. She has been promoted to assistant manag ger at work and will have to do a lot of traveling. Her old car needs to be replaced.			

Is this information a part of...

	CHARACTER	CAPACITY	COLLATERAL
d. She owns a boat worth $5,000.			
e. With her promotion she will receive a raise. She will have enough money to make the payments.			



POINTS TO REMEMBER

- credit is expensive
- costs can be reduced by maintaining a good credit rating
- shop for the best deal by comparing costs

Credit Costs Vary

True credit charges were once hard to understand. People did not know how much they were really paying for credit. On July 1, 1969, the Truth in Lending law was passed. This law has helped consumers know what they are paying for credit. Under this law, the creditor must tell you in writing before you sign any agreement the annual percentage rate (APR) and the total finance charge in dollars and cents.

Comparing Costs

Interest is the cost you pay for the privilege of using credit. It is usually expressed in percentage such as 15%, 15.5% or 21%. The law requires the lender to state the interest in yearly terms, called annual percentage rate (APR). This provides a standard so that you can shop around for the best credit terms. It is your key to comparing costs, regardless of the amount of credit or how long you have to repay it.

The finance charge is the total dollar amount you pay to use credit. It includes interest costs and service charges. Service charges are what the lender (also called creditor) charges you for processing your credit application. You may also add insurance in your credit charges. Life insurance would pay your debt should you die. Disability insurance would make payments should you become disabled.

Suppose you need to borrow $100 for 12 months. At a 15% APR, these charges would be made:

If you want to repay at term (12 months) in one payment, the interest will be $15.00. The reason is that you owe the $100 for a whole year.

Service charge is $5.00.

Life insurance is $6.00.

If you repay in monthly installments, the interest charges would amount to $9.00. The reason is that you are repaying part of the loan each month. You owe $100 for only one month. Each month you owe less.

Service charge is $5.00.

Life insurance is $6.00.

$100.00	Amount Borrowed	$100.00
15.00	Interest	9.00
5.00	Service Charge	5.00
6.00	Insurance	6.00
$126.00		$120.00

At the end of a year, you would owe $126.00

You would pay $120.00 in monthly installments of $10.00.

Lending institutions charge varying interest rates. If an agency assumes a lot of risk, interest rates will be higher. It is to your advantage to keep a good credit by paying debts on time. That way you can qualify for credit at banks and other lending agencies which choose customers carefully.

The cost of credit depends on:

. your credit rating .
. the amount of credit you want .
. where you get it .
. length of time you take to repay .
. the risk the creditor takes .

To reduce the cost of credit:

. shop for the best credit terms .
. compare deals offered by different lenders .
. borrow the least amount possible .
. maintain a good credit rating .

LET'S EXAMINE THE ISSUES

Here are the prices paid by 3 people who bought an AM-FM receiver and turntable for which the cash price was $295.

> Stanley Martin borrowed $295 from a bank at 15%. He will pay $26.63 per month for 12 months.
>
> Daisy Smith bought hers from a mail order store. She paid an interest rate of 18%. Her payments will be $27.04 for 12 months.
>
> Pat Meeks bought hers from a door-to-door sales agent. The interest rate was 21%. She will pay $27.53 a month for 12 months.

Who got the best deal?

_____Stanley Martin

_____Daisy Smith

_____Pat Meeks

Why was that deal better than the other two?

_____a. The interest rate was lower.

_____b. The length of the loan was shorter.

_____c. The seller was more dependable.

Closing Cautions

1. Read and understand any credit contract. Never sign a contract with spaces left blank. Be sure you get a copy of any credit contract you sign.

2. The kind of credit you use often depends on why you need it. A charge account may be easier for small purchases and convenience. A cash loan may be beteer for large items.

3. Always shop for credit. Go to several places. Compare credit charges and annual percentage rates. Compare contracts. Know what they mean, and know what the credit will cost you.

4. Before using credit ask yourself: Do I really need the money or the item? Is having something new worth the finance charge? Can I afford to use credit?

KEY

<u>Page 5</u>

1. a. sales
   b. installment
2. a. cash
   b. installment
3. a. sales
   b. non-installment

<u>Page 9</u>

a. character
b. capacity
c. character
d. collateral
e. capacity

<u>Page 14</u>

Stanley Martin
b.

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