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COMPUTERS IN SECONDARY SCHOOLS: RELATIONSHIPS BETWEEN TEACHERS' ATTITUDES AND SKILLS, AND IMPLICATIONS FOR A TEACHER TRAINING PROGRAM IN COMPUTER LITERACY

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COMPUTERS IN SECONDARY SCHOOLS: RELATIONSHIPS BETWEEN TEACHERS' ATTITUDES AND SKILLS, AND IMPLICATIONS FOR A TEACHER TRAINING PROGRAM IN COMPUTER LITERACY

by

Yong Kwon Kim

A thesis submitted in partial fulfillment
of the requirements for the Doctor of
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Thesis cosupervisors: Professor Bill Carl F. Snider
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To My Family

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CHAPTER I

INTRODUCTION

Introduction

> Most teachers and administrators have little or no knowledge of computers and yet must now make decisions on investing in microcomputer technology that could shape the future of an entire generation of students (Benderson, 1983, p. 3).

Being a professional educator is in part knowing how to adapt to a continually changing society and understanding its effects on the educational process. Schools are always expected to change to meet the demands of parents, pressure groups, and other social forces (Romberg and Price, 1981). Today's computing revolution is a social force demanding the educators' and the schools' attention of computer literacy.

The first computer usage in education was introduced at the end of 1950s. At that time some universities used computers not only for data processing and administration purposes such as accounting, payroll, and student record keeping, but also for instructional research application such as the PLATO project at The University of Illinois (Alessi and Trollip, 1985).

During the past two decades, the cost of computer hardware has dropped 25 percent every year. Also the cost of information storing devices such as computer disks and videodisks have tremendously fallen, so that the average American household has access to the new technology, which is no longer the exclusive possession of large institutions (The Information and Communication Technology Task Force, 1982). In addition , public school districts are performing administrative functions by using computers. School administrators and teachers are also increasingly recognizing another important role of computers in education (Charp et al. 1982).

Computer technology will become an important part of a student's education during the next decade. According to a report to the president from the Information and Communication Technology Task Force (1982) of the University of Iowa, today's students tend to move toward information oriented fields. For example, the enrollment of the University of Iowa has increased 15.4 percent since 1977: Engineering is up 67 percent, Business Administration is up 78 percent, and Computer Science is up 350 percent. It is evident that students distinctly lean toward the areas using information technology (The Information And Communicaton Technology Task Force,1982).

In the future high school graduates will begin to have more computer experience. According to Sjoerdsma (1982) among 75 area high schools in the sixty mile radius of Iowa City, Iowa, only three schools did not have computers.

What is the role of a school in an information age? Loomer (1985) says that educational objectives should provide general directions for a school or a teacher in teaching young people. Therefore, school districts must attain their educational objectives to help a student prepare for the future in an information society. It is vital that educators teach their students with prior knowledge of computer literacy. In spite of growing demands of computer literacy required environment, however, according to many researches and reports, many administrators and teachers are not familiar with computer technology. Despite the growing need for computer training, some do not favor using computers for education (Bradford, 1984).

Recently, new technological developments have given elementary and secondary teachers increasing opportunities to use microcomputers as an instructional tool. Recent reports and recommendations have emphasized that teachers should know the potential role of a computer as a instructional tool in the classroom. Their awareness of its potential could increase the effective usage of computers in creative and innovative ways in the classroom. However, their fear and awe of a computer have impeded implementation of their own classroom computer applications or adaption of other systems to their own needs (Dershem and Whittle, 1980).

Microcomputers appear everywhere in daily life. Stevenson (1983) said " Today's prophets herald the microcomputers as the implementation of reconstruction for American education, and this time their predictions seem likely to come to pass". This trend makes many school districts purchase computers despite financial burdens. But there are still substantial problems such as startup, maintenance, and improvement costs. In spite of remarkable progress many school faculty and administrators are still computer illiterate (Plumer et al. 1984).

History of Computers

The earliest data processing devices originated from the use of fingers, and sticks for counting, and scratches on a rock, knots in a rope and notches cut into a stick.

The first real aid to computation, the abacus, was developed in China around 1200 B.C.

The first person to develop an adding and calculating machine for arithmetic operations was Blaise Pascal. His device was improved by Gottfried von Leibnitz of Germany respectively in 17th century.

The actual history of computer technology has unveiled at tremendous speed in the years following World War II (Baker, 1975; Benderson, 1983; Naisbitt, 1984).

The first operational electronic digital computer, the Electronic Numerical Integrator and Calculator (ENIAC), was developed by John Mauchly and J. P. Eckert at the University of Pennsylvania in 1946. It was a huge machine weighing over 30 tons, having 18,000 vacuum tubes, and many miles of wiring to operate. The UNIVAC I (Universal Automatic Computer), the first commercially available general-purpose electronic digital computer, marks the beginning of the first generation of computers.

With the replacement of vacuum tubes by transistors the second generation of computers began in 1959.

In 1964 the replacement of transistorized circuitry by integrated circuits led to the third generation of computers. The first minicomputer was developed by the Digital Equipment Coopration in 1965.

In the 1970s the use of large scale integration (LSI) semiconductor technology brought the fourth generation of computers. In 1971 through semiconductor technology a microcomputer was developed by M. E. Hoff of the Intel Corporation and Victor Poor of the Datapoint Corporation. The development of a microcomputer is above all things very important in public educational settings. A major technological breakthrough, the development of "the computer on a chip" leads to the second computer revolution (O'Brien, 1984, p. 24).

The decrease of computer hardware costs and size results in developing very large-scale integration (VLSI) circuitry and is one factor in bringing about the fifth generation of computers. Japan and America have already started the research for this generation.

Power of Computer

The computer technology has steadily made its revolutionary impact on society. Recent computers are far more powerful than ENIAC could be. Computers make it possible for man to organize and access huge quantities of information with computing power equivalent to operation at speeds of up to picosecond (trillions of a second) (Benderson, 1983; Davis, 1983; O'Brien, 1983). These speeds cannot be imagined by the human mind.

The computers are also powerful tools for successfully managing the complexity of knowledge and the ever expanding information base. As a tool, the applications of a computer in education are no less important (Molnar, 1978; Deringer et al. 1982; Watt, 1982; Bitter et al. 1984).

Historical Perspectives of Computers in Education

With the development of ENIAC in 1946 computers were first introduced in education by the book, Giant Brains of E. C. Berkeley --- "This book is intended for everyone" (Hunter, 1982, p. 35). The actual use of computers in education is marked with the second generation of computers near the end of the 1950s. Large colleges and universities implemented educational applications of computers for administrative purposes in areas such as payroll, record keeping, and accounting.

In 1959, instructional research and development such as Programmed Logic For Automation (PLATO) started at the University of Illinois (Menashian, 1981; Hunter, 1982; Alessi and Trollip, 1985). Prior to PLATO at the Colorado School of Mines all freshmen were required to learn computer programming. At the secondary level George Washington High School in Denver began a computer science program in 1961 (Hunter, 1982).

With the advent of the third generation of computers which characterized the family or series concept - standardization and compatibility between different models in a computer series, the number of available computers continually increased togther with lower costs for the computer hardware. The major domain was still administrative computing associated with the business functions of the schools.

In the early 1960s, BASIC (Beginner's All-Purpose Symbolic Instruction Code) was developed at Dartmouth College as a simple, easily learned language, which became a widely used programming language for an interactive programming.

In 1972 Time-Shared Interactive Computer Controlled Instructional Television (TICCIT) system was developed using minicomputers at Brigham Young University. Through this system students at different terminals could share the same computer at the same time. During this period PLATO IV was introduced as a large time-shared instructional system.

Seymour Papert at the Massachusetts Institute of Technology developed two projects for children on the basis of Piaget's theories: Logo as a programming language and Turtle as software developed by using Logo.

Minnesota Educational Computer Consortium (MECC) made an approach to instructional applications of computers for the public schools. One common characteristic was that all the projects were accomplished through large and expensive computers.

In the mid-1970's microcomputers were introduced. These microcomputers were more reliable, much easier to use, and much cheaper. The central processing unit of a microcomputer is manufactured on a tiny chip of silicon, less than a quarter-inch in size, and costs only a few dollars. The CPU on a chip is known as a microprocessor. The microcomputer signalled the arrival of the fourth generation of computers. It has made it possible for an individual researcher, a small public school, an individual teacher, and even an individual student to purchase and utilize a microcomputer in schools or homes for general purposes.

Statement of the Problem

What are the relationships between computer literacy, attitudes toward computers, and the topics and skills identifed as components of computer literacy in the education of secondary school teachers?

Specific Questions which are Studied

1. Is there a relationship between the selected demographic characteristics, computer literacy, and the attitudes toward computers of secondary school teachers?
   a) Is there a relationship between subject area taught, computer literacy, and attitudes toward computers?
   b) Is there a relationship between gender, computer literacy, and attitudes toward computers of secondary school teachers?

c) Is there a relationship between age, computer literacy, and attitudes toward computers of secondary school teachers?

d) Is there a relationship between length of teaching experience, computer literacy, and attitudes toward applications of computers in education of secondary school teachers?

e) Is there a relationship between previous training in a computer, computer literacy, and attitudes toward computers?

f) Is there a relationship between actual use of educational applications of computers, computer literacy, and attitudes toward computers?

g) Is there a relationship between using any sources of information about computers, computer literacy, and attitudes toward computers?

h) Is there a relationship between the number of college subject area credit hours, computer literacy, and attitudes toward computers?

i) Is there a relationship between computer literacy and attitudes toward computers of secondary school teachers?

j) Does the relationship between computer literacy and attitudes toward computers vary with the subject area taught?

2. What strategies for teacher training in computer literacy are preferred by secondary school teachers?
    a) Is the choice of strategy related to the teachers' attitudes toward computers?
    b) Is the choice of strategy related to the teachers' computer literacy?
3. Which topics and skills in computer literacy are chosen as important by secondary school teachers?
    a) Which topics and skills are chosen as most important by secondary school teachers?
    b) Which topics and skills are selected as most important within subject areas taught?

This study investigates the above questions.

Purpose of Study

In order to make better informed decisions regarding a curriculum planning of computer literacy and accelerate the implementation of educational applications of computers, it is important to find out what the factors should be to determine the content of a computer literacy instructional program for secondary school teachers.

Need for the Study

Microchip technology has provided schools with small, inexpensive computers. More specifically, there is a concentration of computers in the secondary schools

(Anderson, 1983; Johnston, 1985). Some educators are already computer literate. Some students are more knowledgeable than teachers in computer literacy (Benderson, 1983). School districts throughout the country have begun to establish computer literacy in existing curricular, but it is not enough to solve the problem of computer literacy education (Watt, 1981). The solution to the problem is that computer literacy education should be expanded to all instructional subjects.

One of the school's functions is to prepare young people for the future computer society. To have computer literate students, teachers must be computer literate themselves. It is necessary to investigate and develop programs which help teachers be computer literate.

Definition of Terms

The following terms are defined to provide the precise meaning and scope of key words and phrases used in this study.

1. Attitude --- another step toward generalization, internalization, and centrality to self. Attitudes are a tendency to react in a constant way, favorable or unfavorable, toward something. Attitudes are a feeling, either acceptable or rejectable, toward anything connected with attitude (Reilly and Lewis, 1983).

2. Computer --- A computer is a data processing device that can perform substantial computation, including numerous arithmetic or logic operations without intervention by a human operator during the processing. A computer is an electronic device that has the ability to accept data, internally store, and execute a program of instructions, perform mathematical, logical, and manipulative operations on data, and report the results (O'Brien, 1983). A microcomputer or personal computer is a very small computer with a central processing unit, which is on a single chip, and input, output and secondary storage devices (known as peripherals) all in one case or in several closely attached cases. A microcomputer can be readily used as soon as it is turned on, or it may need a few simple steps to get it ready.
3. Computer application: A computer application is the use of a computer to solve a specific problem or to accomplish a particular job for a computer user. Computer applications are frequently subdivided into education, business, scientific and other application categories (O'Brien, 1983).

Limitation of the Study

This study is limited to the analyses of the data collected from selected secondary school teachers in Area Education Agency 10 (Benton, Jones, Linn, Cedar, Iowa, Washington, and Johnson counties) of Iowa.

Summary

A computer is surely one of the best tools which man has developed since the earliest period. This fact requires that individuals know how to use this technology in order to effectively participate in modern society. Thus, schools face the growing responsibility of providing students with some type of computer-related instruction. It is directly related to computer literacy of teachers.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Introduction

The application of the computer in education surely represents a revolution in education and instruction as well as in the administration of today's schools. Computer usage in a classroom can enhance a teacher's instructional abilities in many subject areas. But many teachers at all levels are not familiar with computer technology nor its impact on society (Williams, 1983; Benderson, 1983; Bradford, 1984). The understanding of the innovation decision process can accelerate the acceptance of computer technology in education.

The Adoption of Innovation

Definition of Innovation

An innovation is defined as any programmed change in terms of an idea, a practice, or an object (material artifact) that is perceived as new by an individual, another unit of adoption (Knight, 1967; Rogers and Shoemaker, 1971; Zaltman et al. 1973; Zaltman et al. 1977; Rogers, 1983).

According to many sources, an innovation can be an idea that an individual or other unit of adoption has been aware of for some time, but that he or it has not yet developed a certain specific attitude. The idea can be either new or old concerning the party adopting the innovation so long as this party would not have previous experiences with the idea (Knight, 1967; Daft and Becker, 1978). That is, an innovation is not necessarily a newly created idea, practice, or material artifact, but it is new to the party adopting it.

The Need of Innovation

The impetus to innovation arises in dissatisfaction with an existing procedure and the resulting desire for a new procedure, or a result of a gap between actual performance and expected performance (Zaltman et al. 1973; Zaltman et al. 1977; Daft and Becker, 1978; Williams, 1983). A discrepancy exists between what a party adopting the innovation is doing and what he believes that he should be doing (Downs, 1966; Hoy and Miskel, 1978). This discrepancy results in a performance gap.

Performance gaps occur between the hopes one has and a consequent dissatisfying achievement. The development of computer technology has steadily reduced the price of microcomputers and has induced many school districts to buy microcomputers. The result is a gap between the availability of computers and the ability of school personnel to use them. This gap stimulates the movement toward computer literacy for personnel and students.

Thus, an important impetus to innovation is the awareness on the part of an innovative adopter that there is a certain gap between the actual and the desirable. This gap stimulates an individual (or another unit of adoption) to look for an innovation in order to improve the existing performance.

Innovation Decision Process

Many theorists have formulated various models to explain and describe the innovation decision process in a variety of ways. These models fall into a variety of categories.

Models with characteristics of the research, development, and diffusion (RD&D) perspective describe the innovation decision process since the beginnings of educational innovation process research (Zaltman et al. 1977). This model is considered to be the most systematic conceptualized process related to educational innovation. It was first developed and designed by Brickell (1961) to aid in bridging the gap between theory and practice in education, and later revised by Clark and Guba (1967) into the research, development, diffusion, and adoption (RDDA) process model (Zaltman et al. 1977). The RDDA model has four sequential phases in the evolution and application of an innovation as follows.

1. RESEARCH: This function will supply the originator or developer of an innovation with the knowledge to clarify the principle and theory for the adoption of a new idea. This stage is an activity designed not to accept the immediate applicability of a new idea, but to secure information regardless of its eventual incorporation into the innovation.
2. DEVELOPMENT: This activity consists of two elements: invention and design. The former involves an action of creating alternatives for solving the existing problems and selecting the best one to be implemented on the basis of research findings, experience, and intuition. The latter includes an action to program the appropriate procedure of adopting innovation. It is a guideline that helps a potential adopter to consider accepting a new technique.
3. DIFFUSION: This activity includes both dissemination and demonstration. Dissemination involves spreading the innovation widely. Demonstration includes developing interest in the innovation. The purpose of this activity is to provide more detailed

information about a new idea so that a potential adopter can evaluate the reasonableness of innovation. A pilot testing of an innovation on a small scale corresponds to this activity.

4. ADOPTION: This stage is the final activity of the RDDA process model. This activity consists of three components: trial, installation, and institutionalization. Trial corresponds to the process of determining the feasibility and utility of a new technique. Installation involves refining and accepting the innovation so that the new technique is suitable for the characteristics of the adopting party. Institutionalization is the successful assimilation of the innovation within the adopting institution.

The assumption of this model is that an adopter is passive and that most educational change comes from outside (Zaltman et al. 1977).

In addition to this model, many other innovation decision process models have been developed. Problem solving models have been supported by Kurt Lewin (1952), and Lippitt, Watson, and Westly (1958).

The primary assumption of problem solving models is that an innovation is a part of the problem solving activity within an individual or a group (Havelock, 1973).

Social interaction models have been advocated by Mort (1964), and Carlson (1965). The assumption of social interaction models is that an innovation diffuses through a social system. Havelock (1969) collected the strongest characteristics of these previous viewpoints and conceptualized "the linkage process" as a possible unifying and integrating idea. This idea focuses on the adopter as a problem-solver. Other models describe the innovation process from various perspectives such as those of individuals or of organizations; with regard to social condition or environment; or including both environmental and organizational concerns.

Computer technological innovations are the new ideas in which this study is interested. Computer technology consists of two components: a hardware aspect and a software aspect. Hardware includes the technological tools as physical objects, and software comprises the information base for the tool.

The innovation decision process is the activity in which an individual seeks information, systematizes it, and reduces uncertainty about the advantages and disadvantages of the innovation. For the purpose of this study, Rogers' innovation decision process model will be used.

The traditional view of the innovation decision process, formerly called the adoption process, was developed by the early rural sociologists for the innovation of farm practices. In 1955, the North Central Rural Sociology Subcommittee for the Study of Diffusion of Farm Practices delineated five stages of the innovation process: awareness, interest, evaluation, trial, and adoption. Their study was influenced by the work of Ryan and Gross, and Wilkening (Rogers and Shoemaker, 1971).

Explanation of the Five Stages

1. Awareness: This activity is the initial stage in the innovation process. In this phase an individual is aware of a new idea but does not possess complete information about it. He develops positive or negative attitudes toward an innovation.
2. Interest: This is the second activity in the innovation process. At this stage an individual becomes interested in the innovation and seeks more information about it.
3. Evaluation: The third stage in the innovation process is evaluation. During this activity an individual considers the applications of the innovation. He becomes an experimenter in the possible applications of an innovation to an existing sitution and in the anticipation of whether he will use it or not in the future situation.

4. Trial: This activity is the fourth stage in the innovation process. This function involves a pilot test of an innovation in an individual's own situation so that he can make a decision about its usefulness for a possible complete adoption.
5. Adoption: The final activity in the innovation process is adoption. During this stage the adopting party makes decisions to put the innovation into full use.

This adoption process has been popular among diffusion researchers in the past. However, this innovation process model has been criticized in that it relies on theoretical reasoning rather than empirical evidence. And because individuals have positive attitudes toward an innovation they do not reject new ideas as a result of the innovation process even though these new ideas may not be acceptable. Rogers and Shoemaker (1971) began using "innovation decision process" as a term broader in scope than "adoption process" as it allows for behavior which takes place after the decision to adopt.

> the innovation decision process is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision (Rogers, 1983, p. 163).

Rogers' theory of innovation consists of five stages: knowledge, persuasion, decision, implementation, and confirmation. Each activity of the innovation decision process will be discussed.

Knowledge

The function of knowledge is an initial activity of the innovation- decision process as described by Rogers. This stage involves a cognitive or mental activity. Rogers states that the innovation decision process begins "when the individual (or other decision-making unit) is exposed to the innovation's existence and gains some understanding of how it functions" (1983, p.164). When an innovation is defined as a programmed change in terms of an idea, a practice or an object perceived to be new by an individual or other unit of adoption, it is very proper that the knowledge stage be the initial activity or function because when an individual knows that an innovation exists he will adopt or reject it in the innovation decision process.

A major question is, which will come first: knowledge or need (Rogers and Shoemaker, 1971; Zaltman et al. 1973; Rogers, 1983). To the individual who is passive in his seeking of information, the knowledge comes first; while the need comes first to the person who is actively seeking information about an innovation. However, Rogers (1983) concludes:

> In any event, available research does not provide a clear answer to this question of whether awareness of a need or awareness of an innovation (that creates a need) comes first. The need for certain innovations, such as a pesticide to treat a new bug that is destroying a farmer's crops, probably comes first. But for many other new ideas the innovation may create the need (p. 167).

As individuals generally tend to expose themselves to an innovation in accordance with their existing beliefs, needs, hobbies, or interests many people are aware of the existence of the innovation but have not adopted it. People are aware that computers exist in real life but many of them do not know how to use them. At every educational level administrators and teachers are aware of the existence of educational computing technology. Few educators, however, are experts in the area, and most of them have little knowledge of the domain (Benderson, 1983). Many specialists at every social level maintain that computer literacy is a prerequisite to effective participation in an information society.

Persuasion

The function of persuasion is the second activity in which an individual establishes his attitude toward an innovation. The principal activity of this stage is emotional. Rogers (1983) describes this activity as follows:

> At the persuasion stage the individual becomes more psychologically involved with the innovation;

> he or she actively seeks information about the new idea (p. 170).

Here the important behavior focuses on where to seek information, what messages to receive and how to translate the received information. It is at this stage that mental trial of an innovation is actual before physical trial is attempted (Havelock and Havelock, 1973; Zaltmanet al. 1973; Rogers, 1983). An individual may mentally apply an innovation to his existing situation or anticipated future condition before determining to adopt or reject the innovation. The important outcome of the persuasion stage is that an individual develops his attitudes toward innovation whether these be favorable or unfavorable (Rogers and Shoemaker, 1971; Zaltman et al. 1973). A lack of understanding and acceptance of computers may lead not only to the ignorance of the use of computer technology in solving problems, but also may limit or reject technological advances (Anderson et al. 1980).

The formation of an attitude toward an innovation contains three components: cognitive, affective, and behavioral (Zaltman et al, as reviewed in Summers, 1971). As an individual moves through these stages he develops beliefs about an innovation on the basis of information he obtains through his social interactions. The affective component may be limited to positive or negative attitudes toward the new idea. The intensity of this emotional component may lead to a more rapid progression so that the remaining stages of the innovation decision process will be passed over. Such factors (beliefs) also influence the actions in the form of an acceptance or a repression of emotion in the innovation decision process.

An individual has a general tendency to expose himself to an innovation, or to perceive it in accordance with his existing situations. The former is usually called selective exposure and the latter is called selective perception. It is at the persuasion stage that selective perception is important since a general perception of the innovation makes an impact on determining an individual's behavior. These perceived attributes of an innovation are introduced by Rogers and Shoemaker (1971) as five of its characteristics: relative advantages, compatibility, complexity, triability, and observability. Each attribute of these characteristics will be described.

Relative advantage: This attribute is the degree to which a potential adopter perceives the innovation as superior to existing alternatives (Zaltman et al. 1973). Its degree of superiority is weighted by economic factors, social factors, and in other ways. The financial cost is correlated with the speed of adoption during the diffusion process (Zaltman et al. 1973; Rogers, 1983). The continuous technological improvements lead not only to the decrease in the production cost but also in the consumer price of an innovation. This results in the increase of the relative advantage, which in turn accelerates a rapid rate of adoption.

With the increasing capability of microcomputers and their decreasing costs, according to Wright (1982), from fall 1980 to spring 1982 the number of micrcomputers available for public school students tripled; 22 % of elementary schools and 66% of secondary schools reported having microcomputers (Lockheed, 1984).

In 1980 less than ten percent of middle schools and junior high schools had even one microcomputer. However, in the spring of 1984 more than two-thirds of the nation's middle schools (generally 6-8) and junior high schools (gnerally 7-9) have at least one microcomputer (Johnston, 1985, p. 50).

Rogers (1983), thus, generalizes on the basis of a comprehensive analyses of research findings that "the relative advantages of an innovation, --- ,is positively related to its rate of adoption" (p. 218).

Compatibility: This characteristic is the degree to which a potential adopter perceives an innovation to be consistent with his previous experiences, present values, or present needs. The more information indicates the compatibility of an innovation, the more rapid the adoption of an innovation. Uncertainty about an innovation is reduced for the potential adopter by indications of a high degree of compatibility. The less compatible an innovation, the slower the rate of the adoption. Zaltman et al. (1973) define compatibility as "the similarity of the innovation to an existing product it may eventually supplement, complement, or replace (p. 37)". This assumes that an innovation relates to and requires changes or adjustments on the part of other elements in the organization or of members of the organization. The innovation is assessed according to such adopter characteristics as personality, emotional attitude, value orientation, past experience, beliefs, age, gender, educational factors, economic factors, social factors, cultural factors, or other factors. Thus, compatibility involves the psychological-social-cultural activity of a potential adopter (zaltman et al. 1973).

Complexity: This is the degree to which a potential adopter has difficulty in understanding and finally using an innovation. The complexity of the innovation surely influences the rate of adoption. The more complex an innovation is in terms of understanding and of using it, the slower its adoption. The innovation may require knowledge of complex concepts in order to understand it or may be complicated in its operation. The innovation whose operation is easy but whose concepts are complicated can be more easily adopted than another innovation whose usage is difficult but whose essential idea is easily understood. Rogers and Shoemaker (1973) and Rogers (1983) generalize that "the complexity of an innovation --- is negatively related to its rate of adoption" (p. 154, p. 231).

Triability: This characteristic is the degree to which an innovation can be tried on a small scale in order to find out how it will actually work in a particular situation. This small scale trial can reduce uncertainty for a potential adopter. However, the small amount of resources available may reinstate the pre-innovation status quo easily. This is called divisibility. Divisibility is related to reversibility because if a change is discontinued the pre-implementation situation can be reinstituted (Zaltman et al. 1977). An individual who has positive experiences in an initial trial of an innovation may feel comfortable in implementing full-scale use of it. Rogers and Shoemaker (1971) and Rogers (1983) generalize that "the triability of an innovation --- is positively related to its rate of adoption" (p. 155; p. 231).

Observability: This attitude is the final characteristic of an innovation as identified by Rogers and Shoemaker (1971) and Rogers (1983). Observability is the degree to which an innovation is made visible to the potential adopter. The results of the use of an innovation which has been highly visible can be more communicable. The communicability of an innovation makes an influence on whether it is considered acceptable (Zaltman et al. 1971). The innovations of recent diffusion researches are technological ideas. The hardware of computers is visible, while the software of computers (program) is less observable. The innovation which contains a hardware aspect usually has relatively more rapid rate of adoption than does that of a software aspect (Rogers, 1983).

Decision

The decision stage is addressed by Rogers (1983) as the activity in which:

> ---an individual (or other decision-making unit) engages in activities that lead to a choice to adopt or to reject the innovation. Adoption is a decision to make full use of action available. Rejection is a decision not to adopt an innovation (p. 113; p. 172).

It is at this stage in the innovation decision process that a potential innovater evaluates the information about an innovation and decides whether to implement it in a full scale (Zaltman et al. 1973). If there is much uncertainty or unfavorable attitudes toward the innovation, there is a greater probability at this stage that the innovation will not be implemented. In some cases an innovation can be triable or untriable. A triable innovation is generally more acceptable (Rogers, 1983).

Implementaion

The fourth stage of the innovation decision process is implementation. This function is identified by Rogers (1983) as an activity which:

> --- occurs when an individual or other decision-making unit puts an innovation into use. Until the implementation stage, the innovation-decision process has been a strictly mental exercise. --- It is often one thing for the individual to decide to adopt a new idea and quite a different thing to put the innovation into use (p. 174).

This activity involves overt behavior demanded by the organization as a new idea is actually implemented. When there is a discrepancy between an individual's attitude toward an innovation and the overt behavior of adoption or rejection demanded by the decision maker, an innovation dissonance (or performance gap) occurs (Daft and Becker, 1971; Zaltman et al. 1973).

Figure 1 shows that there are two kinds of innovation dissonance adopters: a dissonant adopter (II) who has an unfavorable attitude toward the innovation, but is coerced by the overt adoption demand of his organization to adopt the innovation, and the dissonant rejector (III) whose positive feeling about an innovation does not accord with the overt demands of his organization to reject the innovation. As times go by the dissonance in the cases of (II) and (III) can be eliminated if:

> ---(1) individuals change their attitudes to make them consonant with the behavior demanded by the organization, or (2) discontinue the innovation, misuse the innovation, or circumvent the adoptionedict to make their organizational behavior consonant with their attitudes (Rogers and Shoemaker, 1971, p. 311).

Member's Attitude toward the Innovation	Overt Behavior Demanded by the Formal Organization		
	Rejection		Adoption
Unfavorable	(I) Consonant Rejector	<---	(II) Dissonant Adopter
	↑		↓
Favorable	(III)Dissonant Rejector	--->	(IV) Consonant Adopter

Figure 1. Four Dissonant-Consonant Types on the Basis of Individual Attitudes toward an Innovation and the Overt Behavior Demanded by the Organization
(From Rogers and Shoemaker, 1971, p. 311)
Source: adapted from Knowlton (1965, p. 53)
Note that the arrows in the Figure 1 indicate pressures toward consonance.

It is at this stage that the innovation decision process is terminated if a new idea is successfully diffused, institutionalized, and routinized among individuals through an organization, and the concept of a new idea has finally disappeared for most individuals. However, some people may require the fifth stage: the confirmation function, though most individuals end the innovation decision process at the implmentation stage.

Confirmation

The final stage in the innovation decision process is identified by Rogers (1983) as confirmation activity. Rogers (1983) explained this function as follows:

> --- a decision to adopt or reject is often not the terminal stage in the innovation decision process --- (It is) at the confirmation stage (that) the individual (or other decision-making unit) seeks reinforcement for the innovation decision already made, but he or she may reverse this decision if exposed to conflicting messages about the innovation. The confirmation stage continues after the decision to adopt or reject for an indefinite period in time (p. 184).

At this stage, individuals search for a reduction of a dissonance or an avoidance of a dissonance when they encounter a state of dissonance between their attitudes toward an innovation and the overt behavior (adoption or rejection) demanded by the decision unit (Rogers and Shoemaker, 1971; Zaltman et al. 1973). Dissonance may appear when an individual has no choice of another alternative regardless of his favorite or when a better innovation than the existing one shows up. The reduction of the former dissonance was already described. The latter dissonance may be eliminated by replacing the old innovation by the new one. An individual continuously seeks more information that will confirm an already-made decision and as the result of innovation dissonance may decide to reject an existing innovation. The decision to stop using an called a discontinuance. There are two kinds of discontinuance: replacement and disenchantment (Rogers, 1983, p. 186). A replacement discontinuance is a movement to reject an existing idea for the purpose of adopting a better innovation. A disenchantment discontinuance is a decision to reject an existing idea for the purpose of terminating the adoption of the innovation as a result of dissatisfaction with its performance. If an innovation is fully diffused, institutionalized, and routinized into ongoing operations on the part of an adopter at the implementation stage of the innovation decision proess, the adoption of the innovation will be terminated. Otherwise, the process has to move to the confirmation stage. As a result of the confirmation stage some innovations are adopted without uncertainty, while others are rejected as innovation dissonance occurs.

Rogers (1983) generalizes that "innovation with a high rate of adoption had a low rate of discontinuance" (p. 189).

Computer Literacy

Information Society and Computers

Every society has its own time orientation in regard to the rate of change. The agricultural society orientates toward past time; the industrial society is toward the present; and the new information society orientates to the future (Toffler, 1970; Naisbitt, 1982, 1984). While it took 100 years for an agricultural society to shift to the industrial society, the transition to an information society took only two decades (Hade, 1982; Naisbit, 1984). The rapid rate of change to an information society makes it impossible for an individual to have enough time to react and permits him only to anticipate the future. The strategic resource of the industrial society is capital, while that of the post-industrial society is information/knowledge (Molnar, 1978; Hade, 1982; Naisbitt, 1984). The transition to an information society involves the shift from the production-oriented services to knowledge-based industries. Francis Bacon said that "knowledge is power". The meaning of his "knowledge" may be translated into a contemporary concept. Herbert Simon, Nobel prize-winner, states that developments in science and information have changed the meaning of "knowledge" from "having information stored in one's memory" to "the process of having access to information" (Simon, 1971, p. 45). There is too much knowledge today to possess or handle in one's memory personally or institutionally. Access has taken the place of possession (Molnar, 1978). Today, knowledge is information, and information is knowledge. This change implies that as the computer is an information machine (McClain, 1985), contemporary knowledge can be available through the computer.

The Need for Computer Literacy

The computer has become indispensible to the operation of science, business, and governments. As a result, the demand for computer literacy education may have become irresistible (National Council of Supervisions of Mathematics, 1978; Molnar, 1978; Hunter, 1980; Stevens, 1981; Watt, 1982; Deringer et al. 1982; Friedman, 1983; Davis, 1983; Bitter and Camuse, 1984; Naisbitt, 1984).

Davis (1983) states that "the computer is with us literally from birth until death (p. 8)". Simply stated, people live with computers (Bitter and Camuse, 1984). Today, computers actually seem to be almost everywhere and there is simply no way that one can avoid contact with these devices. They are becoming the pre-cradle to the grave technology (Sherman, 1985; Bork, 1985). The rapidly growing impact of computers on society has provided a significant boost to public and professional concern over the need for computer literacy education. More than sixty five percent of all jobs by 1985 will require a work force with computer skills (Menashian, 1981; Benderson, 1983; Naisbitt, 1984; Lindenau, 1984; Pantiel and Petersen, 1984). Only the people with knowledge of computer technology and the computer-supported application survive in the market places (Naisbitt, 1984). Computer literacy is fast becoming a necessary basic skill to effective participation in an information society (Molnar, 1978; Brents, 1980; Watts, 1981; Watt, 1982; Charp et al. 1982; Kearsley, 1982; Bitter and Camuse, 1984).

The primary job of education is to prepare students for their future life. As a person who cannot read is denied access to information and education, so one who is not familiar with computers will be denied access to information and ultimately to equal education. Molar (1978) points out that the next great crisis in American education will be computer literacy if there are no national efforts proposing a computer literacy as a national need. In May 5, 1957 Sputnik shock brought the "catching up with the Russians" crisis to American education. Today's crisis is related to "basic skills" (Molnar, 1978).

There is a wide gap between the needs of the workplace and the skill levels which schools are providing. As a result, three-quarters of America's large corporations must teach basic skills and remedial educaion, spending $300 million annually (Naisbitt and Aburdene, 1985, p. 147). The amount spent simply to upgrade U.S. business employees' basic skills and to train employees is estimated at $60 billion annually (Cromer, 1984, p. 10). In an information society more than one language is necessary (Cromer, 1984), and English and computer literacy will surely be two prerequisite languages (Naisbitt, 1984). Computer literacy as a basic skill may be strikingly achieved only by a strong national effort (Molanr, 1978; ASERI, 1983).

According to Hade (1982), there are three costs of computer illiteracy, which lead to (1) the lack of participation in an information society which can threaten American democracy; (2) one's incomplete education, inadequate training for a job and finally feelings of incompetence; (3) computer phobia that one will be replaced or controlled by computers.

Luehrmann (1980) states that if people are not literate in computer use, two bad things will occur; (1) a leading U.S. industry will not continuously keep a world mass market, and (2) people will not get the various benefits of knowing how to use a computer (p. 140).

Papert(1980) says that there will be a difference between the computer literate culture and the computer iliterate culture which may exist everywhere in the near future (p. 20). Computer illiteracy may be the major barrier to growth and productivity in an information society (Molnar, 1978, 1981). Ignorance of computers will be a major handicap or produce functional illiterates in an information society (Michael, 1968) as lack of skills in reading, writing, and arithmetic does in our present society.

Students should be computer literate and have computers available to them for their future development (MECC, 1980; Stevens, 1981; Williams, 1983; Etlinger, 1983; Naisbitt, 1984; Cromer, 1984). Otherwise, their futures will be crippled. Who is, then, responsible for their computer literacy? The absolute answer will be that the schools must take the responsibility for students' computer literacy. However, the primary burden of computer literacy must fall to the educators (Watt, 1981; Williams, 1983; Slesnick, 1983; Stevensen, 1983; Naisbitt, 1984; Bradford, 1984).

Although computers are so pervasive in every aspect of society that there is a strong agreement that computer literacy is necessary, most educators are unprepared or ill-prepared to teach computer literacy (Williams, 1983; Anderson, 1983; Bradford, 1984), and are struggling with their fear of being left behind the new innovations, and finally being replaced by them (Uhlig, 1983; Benderson, 1983; Friedman, 1983; Williams and Williams, 1984). Some recognize that they should be familiar with computers or microcomputers, but most of them are reluctant to prepare themselves for instructional use of computers (Milner, 1980; Bradford, 1984; Giannelli, 1985)

In a survey done by the Minnesota Educational Computing Consortium (MECC) in 1978, 85 percent of 1300 teachers surveyed agree that it is necessary for secondary school students to achieve a minimal level of computer literacy, but only 39 percent of these teachers report that they use computers in instruction (MECC, 1980, p. 34-38). According to a study conducted by Stevens (1980), 92 percent of K-12 teachers, student teachers, and teacher educators strongly agreed that computer literacy is required by student graduation, but only 6 percent felt that they were familiar with computers. John Lipin, in Educational Times of November 1, 1982, says that over 90 percent of the nation's teachers are unprepared to use computers in instruction (Benderson, 1983).

Few teachers have enough skills needed to use computers in classrooms (Friedman, 1983). There are a number of reasons why teachers are not familiar with computers. One reason is that teachers are not required to know about or use computers for teacher certification. Few college and university programs and courses are developed that might train teachers to use computers in classrooms or provide graduate degrees in computer education (Milner, 1980; Benderson, 1983). Many educators finished their teacher education before the need for computer literacy was identified (Williams, 1983; Bradford, 1984). That is why they are not equipped with the knowledge, attitudes, skills, and experiences which they can use in working with computers in the classrooms (Benderson, 1983). The concepts of computers and the need for computer literacy are relatively new concerns to most teachers (Milner, 1980; Moursund, 1982; Benderson, 1983; Williams, 1983). Teachers do not have time to practice with the computer on their own (Williams and Williams, 1984).

Thus, one of the significant causes of teachers' poor preparation in computing is a general lack of access to computers and opportunities to practice. However, the most serious problem of all is teachers' reluctance to pay more attention to understanding why and how computers work and in what ways they influence society (Milner, 1980; Williams, 1983; Bradford, 1984). Computer literacy involves new ideas, new ways of thinking, and new approaches to teaching (Romberg and Price, 1980; Milner, 1980; Papert, 1980).

Even successful teachers are not always in favor of change. According to Smith (1980), when people are, for the first time, exposed to computers they may react with emotions such as fear, awe, and general uncertainty. Williams and Williams (1984) say that although most teachers may not be directly afraid of computer themselves, there are several circumstances in which they are unwilling to use computers.

They are:

Fear of uncertainty: The confusion about "what a computer is."

Fear of Change: To be asked to do things they do not know how to use.

Fear of technology: They do not understand the operations involved - computers do not operate by visible gears and movable parts.

Fear of Machines on a desk: A computer on the desk in a classroom implies a special commitment.

Fear of machines that aspire to be human - teachers are afraid of computers which will replace them at tasks that have traditionally been part of a teacher's job description.

Fear of visible accountability: Computers make it easy to measure productivity in terms of student's achievement - to meter classroom effectiveness through computer records.

Fear about change in relations with students: Teachers are often less familiar with computers than are some of their students (p. 32-35).

These negative attitudes about computers may produce factors conducive to computer illiteracy. The resistance to innovation may be natural. Foster (1969) points out that resistance may occur because of two reasons: (1) The innovation is not actually called an improvement, but a "pseudo-improvement" since its advantages are outweighed by social and other costs; (2) The innovation may not be perceived as advantageous or may not be willingly tried because of cultural, social, and psychological barriers that discourage innovation (p. 6).

Despite this resistance computer literacy is becoming a prerequisite to participate in an information society. Donald Michael (1968) points out that ignorance of computers results in producing functional illiterates in an information society. There are no computer literate students without computer literate teachers.

Watt (1981) says that:

> Computer literacy is the number one reason teachers give for using microcomputers with their students. With their usual perceptiveness, teachers (must) recognize that a knowledge of computers will soon be a part of basic learning (p. 85).

Williams and Williams (1984) maintain that teacher computing is becoming a necessary skill and a matter directly related to attitudes. Thus, educators should willingly shoulder the burdern of computer literacy in order to help young people for their future.

Definition of Computer Literacy

Under the comprehensive review of literature, computer literacy should be a top educational priority for all students in an information society. The terminology has been widely used, but it is rarely used in the same way. Various authors have their own, favorite definitions of computer literacy. At an educational setting, some key person's defintion can influence the manner in which computers are integrated into school curriculum (Benderson, 1983, p. 4; Roberts, 1985). Therefore, the definition of computer literacy should not be overlooked in educational settings. Numerous definitions have been proposed. They include:

> --- a general understanding of computers: their uses and applications to every day living. Knowing what a computer can and can not do, how they are used in today's world, and how they may affect our lives (Watt, 1981, p. 21)

> --- whatever understanding, skills and attitudes one needs to function effectively within a given social role that directly or indirectly involves computers (Klassen and Anderson, 1982, p. 29)

> --- the ability to recognize problems for which the computer may be a useful part of the solution.
> --- to identify appropriately the experts for assistance in finding solutions using computers (Lombardi, 1983, p. 2)

> --- at least a limited working knowledge of computer hardware and software, along with knowledge concerning applications and implications for society (Mynatt et al. 1984, p. 82).

> --- what every person should know about computers.--- ideas about how a computer is constructed, the ways that computers may be used, how a computer is controlled (i.e., computer programming), and the social issues that arise form the contracts between people and computers (e.g. privacy, career displacement, computerized crime, etc.) (Dennis and Kansky, 1948, p. 10).

> --- the general range of skills and understanding needed to function effectively in a society increasingly dependent on computer and information technology (Coburn et al. 1985, p. 65, 75).

> --- the minimum knowledge, know-how, familiarity, capabilities, abilities and so forth, about computers essential for a person to function well in the contemporary world (Bork, 1985, p. 33).

Some people (e.g. Patient and Peterson, 1984; Bitter and Camuse, 1984) distinguish between computer awareness and computer literacy. Awareness includes knowledge about the impact of computers on daily life and on society, while literacy deals with awareness as well as some ability to use, program, or control the computers. Most people combine these two components under the general label "computer literacy". This study follows the latter approach.

Watt (1982) states that computer literacy is a cultural phenomenon to function effectively and comfortably as a citizen of a computer-oriented society, and he proposes the four areas which computer literate people must achieve: program, software, application, and impact.

One of the most popular definitions of computer literacy may be the following categories or domains suggested by MECC which are:

1. APPLICATION: This area covers the multitude of social and organizational fields into which computers have been integrated. It also covers the general considerations for applying computers to new situations.

2. HARDWARE: This domain deals with the basic vocabulary of computer system components including equipment such as mechanical and electronic devices.

3. IMPACT: Computer literacy also encompasses knowledge of the social effects of computerization, including both the positive and negative impacts of computers on society.

4. LIMITATIONS: This domain is distinguished from the application domain in that it focuses on developing a general sense of the capabilities and limitations of

computing machines. Examples of computer limitations include the fact that computers do not have feelings and consciousness, nor are they able to make value judgements.

5. PROGRAMMING/ALGORITHMS: This domain deals with the ability to read, modify, and construct algorithms and programs.

6. USAGE: While the foregoing areas are largely cognitive in emphasis, this domain involves motor skills for sequencing and execution of certain tasks on the computer or computer terminal.

7. VALUES and FEELINGS: The affective domain centers on developing positive attitudes toward personal use of computers as well as balanced attitudes toward computers as a social force (Klassen and Anderson, 1982, p. 30-31).

There is another definition by Roberts (1985) which is slightly different but similar to that of MECC. He categorizes computer literacy into ten areas which are:

1. Performance: Use computers and programs properly
2. History: Trace development of computers and know historical events and computer evolution.
3. Vocabulary: Have a fundamental understanding of program statement, arithmetic operation, commands, flowchart symbols, structure of the computer, binary number, and computer terminology.
4. Anatomy: Know major parts of computer and recognize different types of computers.
5. Capabilities: Know uses and limitations of computers, the advantages of artificial intelligence.

6. Uses: Know the ways computers are used and how to use them, and use programs for various reasons (tutorial, advanced courses, special interests).
7. Algorithms: Write a simple flowchart, a simple program, flow chart, and write an algorithm to solve more complicated programs.
8. Social: Know the ways computers are used, know about threats to privacy, and complete career project involving computers.
9. Futurists: Know uses of computers to be applied in the future and understand the potential of computer technology today for the creation of art, music, poetry, and other artistic works.
10. programming: Write programs in a real life situation.

Educators must be able to define the parameters of computer literacy as it relates to the classroom. Some definitions have been presented as specific targets for teachers. Anderson (1983) says that when computers are integrated into the elementary and secondary school curriculum, teachers will need some kind of inservice training as well as special courses under seven categories which include:

1. The ability to read and write simple computer programs.
2. The ability to use computer programs and documentation which is educational in nature.

3. The ability to use computer terminology as it relates to hardware.

4. The ability to recognize educational problems that can and can not be solved using the computer

5. The ability to locate information on computing as it relates to education.

6. The ability to discuss the historical development of computer technology as it relates to education.

7. The ability to discuss the moral and human-impact issues as they relate to the societal use of computers as well as the educational use of computers (Anderson, 1985, p. 6-7).

Teacher computer literacy programs should be identified on the basis of student needs. When an inservice program for teacher computer literacy is developed, there are usually two widely believed myths: 1) those who can program are computer literate; 2) those who know the history and impact of computers in a society are computer literate. Hoth (1985) evidences through her inservice training for faculty that these are untrue, and maintains that at the minimum level for teacher computer literacy programs should include the following areas: hardware, basic vocabulary, limitations, distinction of CMI and CAI, morality and ethics, software, current information on computers in education, and evaluation of software.

Foell (1983) and Charp et al. (1982) state that teacher computer literacy program may include activities to overcome negative attitudes or fears about computers.

Table 1

Components of Computer
Literacy: Suggested Basic
Elements

Authors	Hardware	Software	Progm. /Algrth	Uses	Impact
Elliot and Peele (1975)	X	X	X	X	X
MECC (1980)	X	X	X	X	X
Eisele (1980)	X	X	X	X	X
Charp et al. (1982)	X	X	X	X	X
Sediel (1982)	X	X	X	X	X
Watt (1982)	X	X	X	X	X
Moursund (1982)	X	X	X	X	X
*Bork (1982)	X *	X	X	X	X
Luehrmann (1982)	X	X	X	X	X
Aderson(1983)	X	X	X	X	X
Farr (1983)	X	X	X	X	X
Foell (1983)	X	X		X	X
Morrel (1984)	X	X		X	x
*Hoth (1984)	X *	X		X	X
Williams and Williams(1984)	X	X		X	X
Nash and Schwartz (1985)	X	X		X	X
Patiel and Peterson(1984)	X	X	X	X	X
Dennis and Kansky (1984)	X	X	X	X	X
Mynatt and Smith (1984)	X	X	X	X	X
Etlinger et al. (1984)	X	X	X	X	X
Coburn et al. (1985)	X	X	X	X	X
Riedesel and Clement(1985)	X	X	X	X	X
Roberts(1985)	X	X	X	X	X

Progm. Algrth.: Programming/Algorithms
X indicates that the area is included in computer literacy.
* means not including the history of computers.

As described above there is no universal definition of computer literacy. It may be defined differently for various groups depending on the needs of their domains (Benderson, 1983). The common ground identified in the literature indicates that computer literacy includes the minimum level of knowledge about computers and ability or skill in using computers.

On this basis, computer literacy for teachers can be defined as the following:

1. The ability to read, understand, and create simple programs in a real educational setting.
2. The ability to describe the impacts of computers on a society, including educational issues.
3. The ability to describe what computers can and can not do as it relates to an educational setting.
4. The ability to use and evaluate software appropriately.
5. The ability to overcome uncertainty, fear, or anxiety from computer use.
6. The ability to explain basic computer terminology, the history of computers, different types of computers, and computer systems.
7. The ability to distinguish between CMI and CAI.

Computers in Education

The applications of computers in education are generally composed of two major areas at elementary and secondary levels: (1) administrative application and (2) instructional application.

Each of them will be discussed.

Administrative Application

Computer applications for administrative purposes are not new. Most large institutions already began using computers for this purpose in the 1950's. The early major administrative application utilized computers primarily for business functions of schools such as budget/accounting, payroll, and inventory listing. However, the arrival of lower-cost, smaller-sized microcomputers with increased memory capacity can extend these administrative activities to management functions accessible to individual teachers as well as small school districts.

Actually, the effective operation of the school or the classroom depends on various kinds of critical information which administrators or classroom teachers need to obtain (e.g. students' demographic information, school schedule, etc.). It is important in successful administration to store and retrieve data. This process is generally called data processing. Data processing is frequently divided into two areas: manual data processing and electronic data processing. Manual data processing may include using mechanical, electrical, and electronic devices such as typewriters and calculators as data processing tools (O'Brien, 1983). If the quantity of data to be processed is limited and the procedure of processing is simple, the manual approach can be recommended to individuals or organizations. However, if a high volume of work is involved, the manual approach will be cumbersome, tedious, more susceptible to make an error, slower, or sometimes unable to process the data because it requires human efforts. While electronic data processing is a means of using electronic computers to process data automatically. The major strength of this system includes speed, accuracy, reliability, and economy (O'Brien, 1983; Davis, 1983). These characteristics of electronic data processing have made computers invaluable tools of administrative application as well as other applications at both district and building levels.

The scope and scale of computer applications have continously increased. The general listing of these applications is presented in the following tables.

Table 2

The Applications of Computers
in Education: Students

Examples	Sources
Student scheduling and and assignment (D,B)	Grossman and Howe (1965)
Grade reportment (D,B)	Atkinson and Wilson(1969)
Scoring and analysis of tests (D,B)	Watson (1972)
Records of standardized test scores (D,B)	Mihelich (1981)
Class rank report (D,B)	Roecks (1981)
Daily and summary attendence record (D,B)	Lohmeier (1981)
Transcripts(D,B)	Watts (1981)
Records for handicapped students (D,B)	Charp et al.(1982)
ID cards (D,B)	Protheroe et al. (1982)
Academic activities (D,B)	Radin and Grenberg (1983)
Vocational counseling information (D,B)	Hoover and Gould (1983)
Health/immunization files (D,B)	Splittgerber and Stirzaker(1984)
Psychological test records (D,B)	Pantiel and Petersen (1984)
Discipline records (D,B)	Tolman and Allred (1984)
Social and athletic activities (D,B)	Gustafson (1985)
Honors and awards (D,B)	

D: District level, B: Building level

Table 3

The Applications of Computers in Education: Cocurricula Activities

Examples	sources
Special income/ expenditure Accounts (D,B) Athletic statistics (D,B) Participant lists (D,B) Information on rival teams (D,B)	Protheroe et al.(1982)

D: District level, B: Building level

Table 4

The Applications of Computers in Education: Financial/Accounting

Exemples	Sources
Payroll-checks and deduction (D,B) Accounts receivable/ Payable (D,B) Purchase order (D,B) Current operation (D,B) General ledger (D,B) Salary schedule analyses and forcasting (D,B)	Charp et al. (1982) Roecks (1981) Gustafson (1985) Huntington (1984) Watts (1981) Bitter and Camuse (1984) Splittgerber and Stirzaker (1984) Clarida et al. (1981) Watson (1972) Grossman and Howe (1965) Atkinson and Wilson (1969) Protheroe et al. (1982) Hoover and Gould (1983) Pantiel and Petersen (1984)

D: District level, B: Building level

Table 5

The Applications of Computers in Education: Food Service

Examples	Sources
Free/reduced lunch eligibility (D,B)	Protheroe et al. (1982)
Menu planning inventory (D,B)	Radin and Greenberg (1983)
Nutrition (D,B)	Splittgerber and Stirzaker (1984)
Personnel (D,B)	
Food service management: State and Federal regulation (D,B)	
Lunch room program procedure (D,B)	

D: District level, B: Building level

Table 6

The Applications of Computers in Education: Maintenance and Equipment

Examples	Sources
Equipment inventory (D,B)	Grossman and Howe(1965)
Cost records for equipment repair/maintenance (D,B)	Atkinson and Wilson(1969)
Monitor/control of energy usage (D,B)	Watson(1972)
Scheduling of preventive maintenance(D,B)	Roecks(1981)
Room locations/ capabilities (D,B)	Watts(1981)
Vandalism records (D,B)	Charp et al. (1982)
Room assignments/ utilization (D,B)	Protheroe et al.(1982)
	Hoover and Gould (1983)
	Huntington(1984)
	Pantiel and Petersen(1984)
	Bitter and Camuse(1984)
	Gustafson(1985)

D: District level, B: Building level

Table 7

The Applications of Computers in Education: Scheduling

Examples	Sources
Class schedules (D,B) School calendar (D,B) Building and classroom utilization (D,B) Staff schedules within a school (D,B)	Grossman and Howe (1965) Atkinson and Wilson(1969) Watson (1972) Cole (1981) Charp et al.(1982) Protheroe et al.(1982) Radin and Greenberg (1983) Pantiel and Petersen (1984) Bozeman (1985)

D: District level, B: Building level

Table 8

The Applications of Computers in Education: Library

Examples	Sources
Book inventory (D,B) Book order (D,B) Book checkout and overdue book notices(D,B) Bibliographic Information (D,B) Cataloging (D,B)	Grossman and Howe(1965) Watson(1972) Roecks(1981) Watts(1981) Charp et al.(1982) Protheroe et al.(1982) Hoover and Gould (1983) Bitter and Camuse (1984) Pantiel and Petersen(1984) Gustafson (1985)

D: District level, B: Building level

Table 9

The Applications of Computers in Education: Public Relations and Information

Examples	Sources
Mailing lists (PTA members) (D,B)	Grossman and Howe(1965)
Staff directories (D,B)	Long (1985)
Student directories (D,B)	Atkinson and Wilson (1969)
Reponses to inquires (D,B)	Watson (1972)
Alumni contact system (D,B)	Watts (1981)
	Charp et al.(1982)
	Willis et al. (1983)
	Hoover and Gould (1983)
	Radin and Greenberg (1983)
	Huntington (1984)
	Bitter and Camuse(1984)
	Tolman and Allred(1984)
	Pantiel and Petersen (1984
	Gustafson (1985)

D: District level, B: Building level

Table 10

The Applications of Computers in Education: Transportation

Examples	Sources
Passenger lists (D,B)	Grossman and Howe (1965)
Route/driver schedules (D,B)	Atkinson and Wilson (1969)
Vehicle performance and maintenance (D)	Protheroe et al. (1982)
	Radin and Greenberg (1983)
	Splittgerber and Stirzaker (1984)

D: District level, B: Building level

Table 11

The Applications of Computers in Education: Personnel

Examples	Sources
Contract/salary schedule (D,B)	Grossman and Howe (1965)
Employment file (D,B)	Watson (1972)
Leave records (D,B)	Roecks (1981)
Retirement records (D,B)	Watts (1981)
Assignment of personnel to individual school (D,B)	Protheroe et al. (1982)
	Hoover and Gould (1983)
Health records (D,B)	Bitter and Camuse (1984)
Affirmative action records (D,B)	Splittgerber and Stirzaker (1984)
District wide list of approved positions/vacancies (D)	Gustafson (1985)
Job candidate files (D)	
Staff performance records (D,B)	

D: District level, B: Building level

Table 12

The Applications of Computers in Education: Miscellaneous

Examples	Sources
Projection/Simulation for purposes such as collective negotiations (D)	Grossman and Howe (1965)
	Protheroe et al.(1982)
	Charp et. al (1982)
Information about school boundary/census(D,B)	
Student enrollment projections (D,B)	
Research / planning(D,B)	

D: District level, B: Building level

Instructional Applications of Computers

Computers are usually used in school learning processes in two different ways: (1) a learning tool and (2) a subject of instruction.

As a learning tool computers have two major functions: (a)computer-assisted instruction (CAI) and (b) computer - managed instruction (CMI). Teaching about computers rather than with them will result in computer literacy.

Watson (1972) has defined CMI as a system:

> --- that integrates information about the student (e.g. grades, progress in CAI, personality, characteristics, aptitude scores, etc.) and information about available curricula and learning resources in order to prescribe individual programs of instruction, revise curricula and guidance, and facilitate optimal educational resource management (p. 15).

Bitter and Camuse (1984) describe CMI as managing instruction in a classroom or school rather than providing instruction of any type. This is done through computer-assisted testing and recordkeeping which indicates students' mastery or nonmastery of a specific objective.

One comprehensive CMI system designed for use on micrcomputers is introduced by Mclsaac and Baker (1981).

They include:

1. Performance profile reports: This function involves provding individual performance profile reports to the teachers, students or parents regarding the progress of each student.

2. Grouping functions: This domain consists of a teacher's opportunity to dynamically form and reform groups of stuents for a learning process.

3. Grading: This function involves keeping track of grades.

4. Database maintenance: This function allows teachers to enter new students and to delete students who have left the school.

5. Listings and reports: This domain includes all lists and reports presented in alphabetical order of classes, units, instructional groups.

6. Curriculum maintenance: This category involves implementing written curriculum, developing a new curriculum, or modifying an existing curriculum.

7. Program of studies: In this area, a specific program is recorded for each individual student, and the information of each student progress is provided in an individual program.

8. Diagnosis and presentation: This includes the function that diagnoses a student's performance and prescribes appropriate activities.

9. Test scoring: This function involoves recording scanner input, scoring tests, automatically updating student records, and performing test item analyses (p. 42-43).

As described above, computers can take over the time-consuming, tedious, and unrewarding chores which must be accomplished, freeing teachers to handle more important tasks. For example, according to Joos (1980) in grouping functions of CMI, the teachers in a school use CMI systems in five curriculum areas and regroup students every two weeks in reading, mathematics, and science. It takes, without a computer, ten hours for each of five teachers to regroup 200 students in reading. The computer completed the job independently in less than one hour. The CMI program provides reports that can guide the teacher for an individualized instruction leading to mastery of specific objectives (Baker, 1975; Bitter and Camuse, 1984; Gustafson, 1985; Riedesel and Clements, 1985). CMI programs are educational approaches which actually directly benefit the teacher rather than the students.

Computerized management tools are not considered new, although computerized instructional/learning tools are relatively new innovations from the teacher and the student (Hicks and Hunka, 1972; Gustafson, 1985; Manion, 1985; Coburn et al. 1985). However, instructional computer programs have for years dominated areas to teach specific topics such as reading, writing, math, science, language, and composition (Bitter and Camuse, 1984; Coburn et al. 1985; Alessi and Trollip, 1985).

What, then, is instructional computing? It is referred to as CAI (Computer-Assisted Instruction), CBE (Computer-Based Education), CAL (Computer-Assisted Learning), IAC (Instructional-Application of Computer), and CBI (Computer-Based Instruction). According to Salisbury (1971) twenty one terms have often been used in the literature to denote essentially the same process as implied by CAI (Watson, 1972, p. 12). This paper is using the term CAI.

Table 13

The Applications of Computers in Education: Classroom

Examples	Sources
Drill and Practice	Atkinson and Wilson (1969)
Tutorials	Hicks (1972)
Simulation	Roecks (1981)
Instructional Games	Watts (1981)
Computer Programing	Mason (1981)
Practical Aplications	Dennis (1982)
Computer-Managed Instruction	Hausmann and Kepner,Jr. (1982)
	Klassen and Rawitsch (1982)
	O'Conner (1982)
	McClain and Thomas (1982)
	Protheroe et al.(1982)
	ASERI (1983)
	Wills et al.(1983)
	Bitter and Camuse (1984)
	Tolman and Allred (1984)
	Cromer (1984)
	Splittgerber and Stirzaker(1984)
	Dennis and Kansky (1984)
	Vockell and Rivers (1984)
	Pantiel and Petersen (1984)
	Gustafson (1984)
	Riedesel and Clements(1985)
	Long (1985)

Numerious definitions of CAI have been presented. They include:

> --- use of a computer for direct instructional purposes such as learning spelling words, or practicing math skills (Williams and Williams, 1984, p. 162).
>
> --- provides direct educational experiences to students (Gorth et al. 1984, p. 28).
>
> --- a teaching process directly involving the computer in the presentation of instructional materials in an interactive mode to provide and

control the individualized learning environment for each student (Splittgerber et al. 1984, p. 38).

--- the computer takes some of the responsibility for actually teaching the student (Wills et al. 1983, p. 159).

--- the use of the computer as the medium of instruction -- as a means to assist in teaching subjects (Gattis, 1982, p. 47).

The common ground of the above definitions indicates that CAI is really related to direct learning environments.

Burke (1982) described CAI as a programmed learning process or a programmed instruction process with three characteristics: small steps, active responding, and immediate feedback.

Although there are numerous definitions of CAI two major components can be summarized: (1) The necessity of giving ample opportunity to interact with the material to be presented, and (2) actively participating in activities.

CAI is divided into several different modes. In this paper tutorials, drill and practice, simulation, and instructional games are included in CAI. Each of them will be described.

Tutorials

As tutorals imply, a computer takes the role of a tutor and attempts to teach the student about almost every subject matter area in somewhat the same way a teacher would in a one- on-one basis (Bork, 1981; Williams, 1983; Williams and Williams, 1984; Bitter and Camuse, 1984; Pantiel and Petersen, 1984; Coburn et al. 1985).

The format of tutorials is Socratic dialogue (Clements, 1985). That is, the purpose and nature of the lesson is introduced. Information is presented to a student. A questioning and feedback depend on the student's response. If the student's response indicates misconceptions, he can use explanations or review. The process of CAI tutorial is terminated by either the student or the program.

Its strengths are active involvement, individualization, feedback, easy use, and record-keeping. The weaknesses are limited range of feedback and shallow understanding.

Drill and Practice

The most common mode of CAI is the drill and practice lesson (Benderson, 1983; Gustafson, 1985; Coburn et al. 1985; Manion,1985). This application is easy for teachers or students to understand, as it is similar to other common approaches such as flashcards or workbooks. The major difference between tutorials, and drill and practice is that after a number of items is used up in drill and pracice mode the program eventually terminates. Another is that presentation of information in tutorials is replaced by the item selection step.

Currently, according to Vockell and Rivers (1984), drill and practice programs focus on boring factual information that students have already mastered, therefore, they have become unpopular among both students and teachers. Bork (1985) says that more than 90 percent of the software in this mode is worthless today. However, according to the literature, they can be utilized as remedial work for students who are left behind and as individualized practice for different levels of students.

Its strengths are feedback, motivation, easy use, and record- keeping. Its weaknesses are the utilization of low level skills and the failure to develop concepts.

Simulation

In educational activities simulation is a powerful technique that imitates a real situation about some aspects of the world (Bork, 1985; Manion, 1985; Coburn et al. 1985). This approach can be used to provide opportunities for a learner to simulate business environments, societies, and natural phenomenon which could be difficult or impossible to duplicate in a classroom setting (Gustafson, 1985; Pantiel and Petersen, 1984; Bitter and Camuse, 1984). Simulations do not provide feedback in the form of "right" or "wrong", but instead offer the effects of the learner's decision making on the problem (Bell, 1985, p. 38). The purpose of simulations may be stated to include constructing a useful mode of some part of the real situation and exploring it safely, efficiently, and effectively. Throughout this mode students can develop problem-solving ability, intuition about situations, and concepts (Clements, 1985).

Strengths of simulation are individualization, wide range of teaching strategies, and the reflection of real-world application of computers. Its weaknesses are that it is more difficult to use, does not keep records, and is only a partial copy of reality.

Instructional Game

Instructional Games are powerful learning tools which differ from the traditional modes of instruction. They are very similar to simulations. Simulation imitates a real world, but games may or may not simulate a real situation. Instructional games are designed not only to offer students with entertainment but also to provide an environment that facilitates learning of important new concepts. The subject areas which they have aimed at include language, mathematics, logic, physics, chemistry, biology, economics, business, medicine, and geology (Tolman and Allred, 1984).

Students ,through playing these games, may learn how to process facts, logically infer and solve a problem. They require intrinsically motivating characteristics such as the ability to fantasize, to be curious, and the need to be challenged (Coburn et al. 1985). They also have a positive pedagogical value and can significantly improve learning (Tolman and Allred, 1984). They provide motivation for the extensive practice that is required for some to be proficient in basic skills (Burke, 1982; ASERI, 1983, p. 14).

The instructional process of this mode is very similar to that of simulation. The only difference between them is the addition of an optional input by an opponent in playing games.

Strengths of games are the developments of problem-solving ability, and knowledge. They are also individualized, and allow a wide range of teaching strategies. However, games are more difficult to use, and they do not record the students' learning progress.

Findings

In reviewing the literature, advantages of CAI have been generally stated to include: (1) individualization; (2) learning faster; and (3) visualization. Gleason(1981) stated that computerized instructional programs have an advantage of a substantial savings in time for learning as compared with conventional instruction. Bell and Taylor (1979), Benderson (1983), Kulik et al. (1983), Cromer

(1984), Gustafson (1985), and Riedesel and Clements (1985) also concur. CAI can help students create realms of experience useful in the formal learning environment such as aiding in insight and intuition about physical processes (Bork, 1980, p. 60).

Many researchers have investigated the effectiveness of computers as learning tools. CAI can improve student achievement (Gleason, 1981; Charp et al. 1982; Kulik et al. 1983; Berkeley, 1984; Tolman and Allred, 1984; Clements, 1985; Bork, 1985).

A study conducted by Burns (1981) focused on the effectiveness of computer-assisted mathematics instruction as compared to traditional mathematics instruction at the elementary and secondary levels.

Findings were as follows:

A mathematics instructional program supplemented by CAI drill/practice or tutorials was significantly more effective in terms of student achievement than a program utilizing only traditional instructional methods.

CAI drill/practice programs were significantly more effective in student achievement for both high achievers and disadvantaged students. The achievement of average level students was not significantly enhanced by supplementary CAI drill/practice.

At the intermediate grade level boys had significantly greater achievement gains in CAI drill/practice than girls.

Tutorial CAI-supplemented instruction was related to gains associated with mathematics achievement.

There is virtually no evidence to suggest the existence of a relationship between experimental design features and study outcomes (Burns and Bozeman, 1981, p. 37).

As far as achievement gains are concerned, Clement (1981) concluded on the basis of reviewing the research literature that most studies of CAI report approximately a 90 percent positive acceptance at all levels. Five major reasons given for this positive attitude were addressed: self-paced, lack of embarrassment, immediate feedback, a generally better feeling, and lack of subjective evaluations.

Luehrmann (1979), one of the early pioneers in educational applications of computers, stated that CAI programs may reduce the instructional cost, divide it to appropriate learning levels, identify its content areas, improve instruction, and hold teachers and schools accountable to their young people (p. 135).

Although a significant amount of research has already been conducted on the effects of computers on education, the results to date are rather controversial and inconclusive. Sheingold et al. (1983) stated that as a result of using microcomputers in schools at three diverse sites, no solid proof was found that they were effective in student learning. In another survey by Lockeed et al. (1984), the gain in educational computing was related to gender, grade, mathematics course type and mathematics section type. Males, young students, students in college preparatory mathematics courses, and students in advanced sections of mathematics courses achieved relatively more gains than females, older students, and students enrolled in other mathematics courses or section levels. According to Bradford (1984), the number of computer exposures is generally related to gain, but there is no evidence of the existence of a relationship between access to and experience with computers and student gain (Sheingold et al. 1983). This raises a question of why inequities of gain occur. Simply stated, the effects of computers on learning may be influenced by a number of variables. The proper structure and implementation of CAI programs might improve the learning process.

Summary

In this chapter reviewing the literature focused on the nature of this study.

This study attempted to examine theoretical perspectives of an innovation in education. The innovation decision process was discussed in relation to acceptance of educational computing as an innovation.

Computer technology has influenced our society in a variety of ways. An attempt was made to investigate the need of computer literacy, various definitions of computer literacy, and applications of computers in educational setting. Also, it attempted to determine the minimum level of teacher competency required for instruction of computer technology.

CHAPTER III

METHODS AND PROCEDURES

Introduction

The purpose of this study was to examine relationships between attitudes toward computers and computer literacy among secondary school teachers, and to determine which computer topics and skills secondary school teachers need in educational settings. Data were collected at the secondary school level (grades 9 to 12) from teachers directly involved with young peoples' education. This study was designed to contribute to the basis for the design of curriculum planning and technical assistance services for secondary school teachers in educational applications of computer technology

The theoretical perspective developed in the beginning of chapter II indicates the need to examine the relevant experience, attitudes and characteristics of teachers in relation to acceptance of computer technology as an innovation.

The methods and procedures used to conduct the study are described in this chapter. This chapter consists of five sections: 1) population and sample, 2) instrumentation,

3) administration of instrumentation, 4) data collection and 5) data analyses.

Population and Sample

The population of this study consisted of language arts/English, mathematics, science, social studies/social science, and business teachers in Area Education Agency 10, one of 16 Area Education Agencies in the state of Iowa.

The sample for this study was selected from all secondary school teachers in AEA 10 who taught in the 5 subject areas listed above. The original sampling plan was to select two (2) mathematics teachers, two (2) language arts/English teachers, two (2) science teachers, two (2) social studies/social science teachers, and two(2) business teachers from each high school of each district. If the number of teachers in a certain subject area of a high school was less than two, the plan was to utilize the one available for that school. If the school did not have any teacher in one of the five subject areas, the area was left out.

The first step in selecting this sample was to enlist the aid of the superintendent of each school district. On October 31, 1985, letters were sent to the superintendents of all 39 school districts requesting their participation. (See Appendix B). Stamped return address postcards were provided with the letters for superintendents to acknowledge or decline participation. Thirty six (36) superintendents agreed to participate in the study. Three declined, explaining they had participated in several surveys earlier in the year.

The second step in selecting the sample immediately followed receipt of the superintendents' agreement to participate. Letters were mailed to all high school principals in participating districts explaining the purpose of the study and requesting them to report the number of teachers they had in each of the five subject areas. (See Appendix C). Stamped return envelopes were provided for the principals' replies. Three days after the letters were sent, follow up telephone calls were made to each principal.

After all replies were received, the sample was defined on the basis of the principals' reports.

Administration of the Instrumentation

Survey instruments and instructions were delivered to the building principal of each secondary school. The principals were asked to assist in the selection of teachers in their schools on the basis of the requested number of teachers and their availability in five (5) subject areas. (See Appendix D).

The selected teachers were asked to participate in the survey. (See Appendix E). They were requested to complete the questionnaire and to return it to their principals. The principals were asked to collect them and return them to the researcher by November 26, 1985. Stamped envelopes were provided for returning the questionnaires.

Instrumentation

A comprehensive review of the literature identified the research problems and the survey items. These items were classified, combined, and expanded into a meaningful list.

Survey research methodology was used, and data was collected through a questionnaire. The use of a questionnaire seemed most appropriate in this situation because it is 1) economical in both money and effort, 2) easy to reach people who are difficult to contact, and 3) uniform in the way the questions are asked, to maximize comparability of the responses. Of course, in interpreting the responses, one must be aware that it is difficult to monitor the reluctance or evasiveness of the respondents and that the respondents may have misunderstood some of the questions or provided inadequate answers (Mouly,1978).

The survey instrument was arranged into four sections. (See Appendix A). The first section was for gathering demographic information about individual respondents. It also included items related to training strategy, which were adapted from survey questionnaires of Williams (1983).

Table 14

Frequency Distribution of Survey Items of Attitudes toward Computers

Component Area	Item Number	Total
Using Computers	Q1, Q4, Q6, Q7	4
Feelings About Computers	Q2,Q3,Q5,Q10,Q11 Q12,Q14,Q16,Q18 Q19	10
Computers In Education	Q8, Q9, Q14,Q15 Q17,Q20,Q21	7
Total	21	21

Part II of the survey instrument assessed attitudes toward computers. Elkins' and MECC survey questionnaire of attitudes toward computers were the source documents employed in developing the inventory. The inventory consisted of three domains: using computers, feelings about computers, and computers in education. (See Table 14).

The third section of the survey instrument was designed to measure the level of computer literacy. Twenty five (25) questions related to computer literacy covered each of five (5) component areas thought to be integral parts of computer literacy. (See Table 15). The total score was based on the

Table 15

Frequency Distribution of
Computer Literacy Survey Items

Component Area	Item Number	Total
Hardware (Familiarity With Terminal Use)	Q1, Q5, Q10,Q14 Q22	5
Programming (How Computers are Instructed)	Q6, Q15,Q23,Q24 Q25	5
Impact(Social Issues)	Q3, Q8, Q12,Q17 Q21	5
Software And Data Processing (How Computers Do Their Work)	Q4, Q9, Q13,Q18 Q19	5
Applications (How Computers are used)	Q2, Q7, Q11,Q16 Q20	5
Total	25	25

number of correct responses. Some items of the third section were derived and modified from those of MECC (Minnesota Educational Computer Consortium) survey. Others were created by the researcher.

Section IV was for determining which topics and skills the secondary school teachers think to be important in applications of computers in education for themselves. Thirty (30) statements were developed and a four (4) point scale was used to measure the degree of importance. Most of these items were also modified from those of MECC and Williams' survey questionnaires. The remaining items were developed by the researcher.

Table 16

Frequency Distribution of Survey Items of Topics and Skills in Applications of Computers in Education

Component Area	Item Number	Total
Components and function of computer systems	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8	8
Operating and programmin a computers	Q9, Q10,Q11,Q12 Q13,Q14,Q15,Q30	8
Applications of computers	Q16,Q17,Q18 Q19 Q20,Q21,Q22,Q23 Q24,Q25,Q26,Q27 Q28,Q29	14
Total	30	30

Reliability: "Reliability addresses the question of whether or not a measuring instrument is consistent (Vockell, 1983, p. 22)". An instrument is reliable to the degree to which the same scores can be reproduced when the same objects are measured repeatedly. In this study, reliabilities were established by computing coefficient alpha as recommended by Cronbach (1970). Alpha reliabilities for the attitude inventory and the computer literacy measure were 0.8838 and 0.7818, respectively. These values are adequately high.

Validation: Two steps were taken for the purpose of revising and validating the survey instrument. In the first step, experts reviewed and critiqued a preliminary draft of the instrument. Three people were chosen on the basis of their professional expertise in the area of educational applications of computers. Each expert was visited by the researcher and asked to participate in evaluating the survey questionnaire. The participants received preliminary survey questionnaires and examined the appropriateness of the items. Then the researcher discussed the questionnaire with each reviewer. Based on the comments from these reviewers, the questionnaire was then refined.

The refined questionnaire was summitted to the committee members of this study in the second step of the development process. They considered the content in light of the proposed research questions and made further suggestions for refinements. On the basis of these recommendations, the final version of the questionnaire was prepared.

Data Collection

The building principals of thirty-six (36) high schools were mailed and called to inform them of the study and the districts' agreements to participate, and they were asked to report the number of teachers available to the five subject areas in their schools using self-addressed return envelopes. On the basis of their reports the appropriate number of questionnaires were mailed to the building principals. The principals were asked to distribute the instruments to the selected teachers, to collect them, and to return them by using the stamped envelopes provided. The selected teachers were asked to assist in the survey questionnaire. Follow-up telephone calls were made to either collect or remind building principals of the terminationtion date for instrument returns. November 26, 1985 was set as the deadline for returns. However, all survey questionnaires received by December 4, 1985 were included.

Data Analysis

All data were recorded at the Department of Data Entry in the Weeg Computing Center at the University of Iowa. Recorded data were transferred into IBM 3350 - Wylbur System. The statistical analysis was conducted by using a statistical Package for the social sciences (SPSSx).

Attitude scores were computed by summing each teacher's ratings to the 21 items on the scale. Because some items were stated inversely to minimize response set, scores for each item were assigned to reflect acceptance of computers. Thus, for positively worded items such as "I think I am capable of learning to use a computer.", "Strongly Agree" was scored as "5" and "Strongly Disagree" was scored as "1". In contrast, for negatively worded items such as "I am afraid of computers," "Strongly Disagree" was scored as "5" and "Strongly Agree" was scored as "1".

Literacy scores were computed by counting the number of items answered correctly in the 25 item measure of computer literacy.

Demographic data was analyzed by computing the number of teachers in each response category.

For cases in which two groups were compared, t-tests were employed to examine whether differences between mean scores were statistically significant. Demographic characteristics were the independent variables, and attitude and computer literacy scores were the dependent measure.

Comparisons of more than two groups were made using the analyses of variance. Demographic variables were the independent variables and scores on attitude and computer literacy scales were the dependent measures. One way analysis of variance was used to identify significant differences among mean scores. SPSSx provided not only F-values, but also specific information about comparisons between all pairs of groups.

Pearson product moment correlations were used to assess the magnitude of the relationship between attitudes toward computers and computer literacy.

The 5 percent level (that is, $p < 0.05$) was considered an acceptable level of confidence to reject the null hypothesis (Tuckman, 1978). It is simply an arbitrary level accepted by social scientists as a decision point to accept a finding as reliable or to reject it as sufficiently improbable to have confidence in its recurrence.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

The purpose of this study was to examine the relationships between teachers' attitudes toward computers and their skills in educational computing, and to specify topics for an inservice training program in computer literacy.

In this chapter, the results of data analyses are presented in the following order.

1. Sample Demographics
   - a) Summary of number and percent by subject area taught
   - b) Summary of number and percent by gender
   - c) Summary of number and percent by age
   - d) Summary of number and percent by length of teaching experience
   - e) Summary of number and percent by previous computer training
   - f) Summary of number and percent by actual use of applications of computers
   - g) Summary of number and percent by use of sources of information such as books and magazines about computers

2. Relationships between attitudes toward computers and sample demographics

   a) Attitudes toward computers and subject area taught

   b) Attitudes and gender

   c) Attitudes and age

   d) Attitudes and length of teaching experience

   e) Attitudes and previous computer training

   f) Attitudes and actual use of applications of computers

   g) Attitudes and use of sources of information such as books and magazines about computers

3. Relationships between computer literacy and sample demographics

   a) Computer literacy and subject area taught

   b) Computer literacy and gender

   c) Computer literacy and age

   d) Computer literacy and length of teaching experience

   e) Computer literacy and previous computer training

   f) Computer literacy and actual use of applications of computers

   g) Computer literacy and use of sources of information such as books and magazines about computers

4. Relationships between attitudes toward computers and computer literacy by demographics
   a) Attitudes toward computers and computer literacy by subject area taught
   b) Attitudes and computer literacy by gender
   c) Attitudes and computer literacy by age
   d) Attitudes and computer literacy by length of teaching experience
   e) Attitudes and computer literacy by previous computer training
   f) Attitudes and computer literacy by actual use of applications of computers
   g) Attitudes and computer literacy by use of sources of information such as books and magazines about computers
   h) Attitude and computer literacy by the number of college subject area credit hours
5. Training strategy for staff development
   a) Training strategy for computer courses or inservice
   b) Relationship between attitudes toward computers and training strategy
   c) Relationship between computer literacy and training strategy
   d) Attitude ranking by mean scores

6. Components of a computer literacy curriculum for teachers
    a) Topic ranking by mean scores
    b) Differences by subject matter area

Analysis of the data was accomplished through the SPSSx (Statistical Package for Social Sciences) which was available at the Weeg Computing Center of the University of Iowa. The computer utilized was IBM 3350-Wylbur System.

The results were based on data collected from questionnaires administered to selected secondary school teachers (9-12) in Iowa's Area Education Agency 10. Five subject areas were included in this study- language arts/English, mathematics, science, social studies/social science, and business.

Attitudes toward computers were assessed with a 21 item scale. Respondents indicated the extent to which they agreed or disagreed with each statement on a 5-point scale. Some items were stated positively and others were stated negatively to avoid response bias. Total attitude scores were obtained by summing the responses to each individual item.

Computer literacy was assessed by a 25 item multiple-choice test. Items assessed knowledge of hardware, software, applications, social issues and programming.

Scores for each respondent were computed by counting the number of items answered correctly.

Alpha reliability for the attitude scale was 0.8838, and that for computer literacy was 0.7818. The Pearson correlation coefficient was used to examine the relationships between attitudes toward computers and computer literacy.

Further, a descriptive analysis of attitude, computer literacy, and topics and skills of computer applications in education was completed using selected demographic information.

Effects of the demographic variables as independent variables and computer literacy and attitudes as dependent variables were examined with t-tests and F-tests. T-tests were used to examine the differences in mean ratings for demographic variables with 2 values, such as gender, and one-way analysis of variance (ANOVA) tests for differences in mean scores were used for demographic variables with more than 2 levels.

Finally, the importance of topics for a teacher training program was assessed using a 30 topic inventory. Respondents rated the importance of each topic using a 4 point scale. Mean ratings were computed by adding all individual ratings and dividing by the number of raters. In addition, the ranking of the ratings within each subject matter area was computed to help in identifying any differences in the relative importance of topics related to subject area taught.

Sample Demographics

Survey questionnaires from the thirty-six (36) high schools were returned by teachers from each of the five subject areas. Table 17 summarizes the number and percent of teachers in each subject area from the school districts that agreed to participate in the study.

The column labeled "total" reports the number of returned survey questionnaires for each school district. In the next column the return rate for each school district was computed by dividing the number of returned questionnaires by the number of distributed questionnaires.

The projected sample size from 36 high schools was three hundred and seventeen (317). The number of participants who returned the questionnaires was three hundred and four (304). That is, ninety six percent (96%) of the distributed questionnaires were returned. Fourteen, or four percent (4%), of the returned questionnaires could not be used because responses to many items were omitted or the respondents were not from one of the five specified subject areas. Therefore, the effective return rate for the survey questionnaire was 92%, or two hundred and ninety one (291) teachers.

Table 17

Number and Percent of Respondents by District

District	Teachers						
N=36	L.& E.	Math.	Science	Social	Bus.	Total	Percent
1	2	2	2	2	1	9	100 %
2	2	2	1	1	1	7	100 %
3	2	0	1	1	1	5	50 %
4	2	2	1	2	1	8	89 %
5	2	2	2	2	2	10	100 %
6	1	2	2	2	1	8	89 %
7	2	1	1	1	2	7	100 %
8	1	2	1	1	1	6	67 %
9	2	1	2	2	2	9	90 %
10	1	1	1	2	1	6	100 %
11	2	2	2	1	1	8	89 %
12	2	2	1	2	1	8	89 %
13	2	2	2	2	1	9	100 %
14	1	2	1	2	1	7	78 %
15	2	2	2	2	1	9	100 %
16	2	2	1	1	2	8	80 %
17	1	1	1	0	1	4	80 %
18	2	1	2	2	1	8	100 %
19	2	2	2	2	2	10	100 %
20	2	1	2	2	2	9	100 %
21	2	2	2	2	2	10	100 %
22	2	2	2	2	2	10	100 %
23	2	1	1	1	1	6	60 %
24	2	2	2	2	1	9	90 %
25	2	2	1	2	1	8	100 %
26	1	1	1	1	0	4	80 %
27	2	1	2	2	0	7	88 %
28	1	1	2	2	2	8	100 %
29	2	2	2	2	1	9	100 %
30	2	2	2	2	1	9	100 %
31	2	2	2	2	2	10	100 %
32	2	1	2	2	1	8	100 %
33	2	2	2	2	2	10	100 %
34	2	2	2	2	2	10	100 %
35	2	2	2	1	1	8	89 %
36	2	2	2	2	2	10	100 %
Total	65	59	59	61	47	291	92 %

L.& E. = Language arts and English, Math. = Mathematics
Social = Social studies/Social science, Bus.= Businesss

Summary of Number and Percent
by Subject Area Taught

Table 18

Summary of Frequency and
Percent by Subject Area Taught

Subjects	N	Percent	Cum. Percent
L./E.	65	22.2	22.2
Math.	59	20.3	42.6
Science	59	20.3	62.9
Social	61	21.0	83.8
Business	47	16.2	100.0
Total	291	100.0 %	100.0 %

L./E.: Language Arts/English
Social: Social Studies/Social Science
Cum. Percent: Cumulative Percent

The number and percent of respondents from subject area are presented in Table 18. As shown in Table 18, the areas were evenly represented, with about 20% of the sample in each group. The largest group was the language arts/English teachers with 65 respondents or 22.2%, and the smallest group was business teachers with 47 respondents or 16.2%.

Summary of Number and Percent by Gender

The number and percent of all respondents by gender are presented in Table 19. One hundred and seventy eight (178) or 61.2%, are male teachers, while one hundred and thirteen (113) or 38.8% are female teachers.

Table 19

Summary of Frequency and Percent by Gender

Gender	N	Percent	Cum.Percent
Male	178	61.2	61.2
Female	113	38.8	100.0%
Total	291	100.0%	

Table 20

Summary of Frequency and Percent by Age

Age	N	Percent	Cum. Percent
21-30	64	22.0	22.0
31-40	120	41.2	63.2
41-50	73	25.1	88.3
Over 50	34	11.7	100.0%
Total	291	100.0 %	

Summary of Number and Percent by Age

Respondents checked their age group, and a summary of the number and percent of respondents in each age group is shown in Table 20. The largest age group was teachers between 31 and 40. This group had one hundred and twenty (120) or 41.2% of all respondents. The smallest group was the over 50 group. It had only 34 teachers, or 11.7% of the respondents.

Summary of Number and Percent by Length of Teaching Experience

Table 21

Summary of Frequency and Percent by Length of Teaching Experience

Length(Years)	N	Percent	Cum. Percent
0- 5	48	16.5	16.5
6-10	52	17.9	34.4
11-15	71	24.4	58.8
16-20	56	19.2	78.0
Over 20	64	22.0	100.0%
Total	291	100.0%	

Cum. Percent: Cumulative Percent

The amount of teaching experience for the responding teachers is presented in Table 21. Teachers are fairly evenly distributed among the five experience groups, with slightly more teachers in the 11-15 years group, and slightly less in the 0-5 years group.

Summary of Number and Percent by Previous Computer Training

A summary of number and percent of teachers with previous inservice training or courses on computer use in education is shown in Table 22. Approximately two thirds (2/3) of the sample reported they had received training in the use of computers. One hundred and ninety six (196) or

Table 22

Summary of Frequency and Percent by Previous Training about Computers

Training	N	Percent	Cum. Percent
No	95	32.6	32.6
Yes	196	67.4	100.0%
Total	291	100.0%	

Cum. Percent: Cumulative Percent

67.4% of all respondents indicated they had attended inservice training or courses related to educational uses of computers.

Summary of Number and Percent by Actual Use of Computer Applications

Table 23

Summary of Frequency and Percent by Actual Use of Computers

Experiences	N	Percent	Cum. Percent
Never	37	12.7	12.7
In Classes	170	58.4	71.1
Outside Classes	84	28.9	100.0%
Total	291	100.0%	

Cum. Percent: Cumulative Percent

Table 23 includes a summary of the number and percent of teachers who had ever used a computer. Those who reported they had used a computer indicated whether they had used it in their own classrooms or if they had only used it outside their classrooms. One hundred and seventy (170) or 58.4 % of all respondents had used computers in their own classrooms. Eighty four or 28.9% of the sample had used computers outside classrooms. Two hundred and fifty four (254) or 87.3 % of all sample teachers were using computers for some purposes. This number or percent of teachers using computers is an amazing phenomena.

According to Bradford (1984), in 1983, 62.14% of selected teachers of Quad-City area secondary schools (grades 7 and 8) in both Iowa and Illinois were using computers. Although the geographic areas examined are different, they are sufficiently compared to suggest that the percent of teachers using computers is increasing rapidly.

Summary of Number and Percent by Using Sources of Information Such as Books and Magazines about Computers

A summary of frequency and percent of respondents using sources of information such as books and magazines about computers at least once a month is shown in Table 24. The "Yes" group is the respondents who reported using any

Table 24

Summary of Frequency and Percent by Using Sources of Information Such as Books and Magazines about Computers at Least Once a Month

Information	N	Percent	Cum. Percent
No Group	210	72.2	72.2
Yes Group	81	27.8	100.0 %
Total	291	100.0 %	

Cum. Percent: Cumulative Percent

sources of information such as magazines, books, and any periodicals about computers at least once a month. The "No" group is the respondents who do not regularly use information sources about educational computing. Eighty one teachers or 27.8% of all repondents are the "Yes" group, while two hundred and ten (210) or 72.2% of the entire sample are the "No" group.

Relationships between Attitudes toward Computers and Sample Demographics

Attitudes toward Computers and Subject Area Taught

Table 25

Attitude Mean Scores by Subject Area Taught

Subjects	N	Attitude Mean	S.D.
L./E.	65	81.26	12.10
Math.	59	90.25	8.04
Science	59	86.22	10.19
Social	61	81.06	11.18
Business	47	88.76	9.86
Total	291	85.26	11.04

L./E.: Language Arts/English
Social: Social Studies/Social Science

Table 26

Analysis of Variance: Attitudes toward Computers by Subject Area Taught

Source	D.F.	S.S.	M.S.	F-Ratio	F-Prob.
B.Groups	4	4216.11	1054.02	9.67	P<0.005
W.Groups	286	31148.03	108.90		
Total	290	35364.15			

B.Groups: Between Groups, W.Groups: Within Groups
D.F.: Degree of Freedom, S.S.: Sum of Squares
M.S.: Mean of Squares, F-Prob.: F-Probability

The mean attitude score for each group is presented in Table 25.

The results of ANOVA of the effect of subject area taught on mean scores for attitudes toward computers are reported in Table 26. The F-Ratio of 9.67 indicates there are significant differences between subject area group means ($p < 0.005$).

Table 27

Significant Differences of Attitudes by Subject Areas Taught

Attitude Mean	Each Group	Grp4	Grp1	Grp3
81.06	Grp4			
81.26	Grp1			
86.22	Grp3	*	*	
88.76	Grp5	*	*	
90.25	Grp2	*	*	*

Group 1: Language arts/English teachers
Group 2: Mathematics teachers, Group 3: Science teachers
Group 4: Social studies/social science teachers
Group 5: Business teachers
(*) denotes pairs of groups significantly different at the 0.050 level.

As presented in Table 27, there are significant differences between subject area group means at the 0.05 alpha level. Mathematics teachers showed the most favorable attitudes toward computers with a mean score of 90.25. This score was slightly higher than business teachers and significantly higher than teachers in the other three subject areas. Business teachers ranked second in attitudes with a mean score of 88.76 and science teachers were a close third with a mean score of 86.22. Language arts/English and social studies/social science teachers had the lowest mean scores among entire sample groups (81.26 and 81.06 respectively), scoring significantly lower than the other three groups.

Attitudes and Gender

Table 28

Attitudes toward Computer by Gender

Gender	N	Attitude Mean	S.D.	T-Value
Male	178	85.12	11.23	-0.26
Female	113	85.46	10.78	(D.F.=289)
Total	291	85.29		

* p= 0.799

The attitude mean scores and t-value are presented for gender in Table 28. Although it is not significant, female teachers showed slightly more favorable attitudes toward computers than did male teachers.

Attitudes and Age

The attitudes toward computers by age are summarized in Table 29. As shown in Table 29, attitude mean scores

Table 29

Attitudes toward Computers by Age

Age(Years)	N	Attitude Mean	S.D.
21-30	64	84.70	11.46
31-40	120	85.74	10.30
41-50	73	86.27	12.04
Over 50	34	82.44	10.43
Total	291	85.26	11.04

increased with age for the first 3 age groups. The respondents between 41 and 50 had the highest score of 86.27. However, in the over 50 group, the attitude mean score fell to 82.44, the lowest score of any group.

Table 30

Analysis of Variance:
Attitudes toward Computers by
Age

Source	D.F.	S.S.	M.S.	F-Ratio	F-Prob.
B.Groups	3	392.89	130.96	1.07	p=0.36
W.Groups	287	34971.25	121.85		
Total	290	35364.15			

B.Groups: Between Groups, W.Groups: Within Groups
D.F.: Degree of Freedom, S.S.: Sum of Squares
M.S.: Mean of Squares, F-Prob.: F-Probability

While a trend in the mean scores is evident, the analyses of variance (ANOVA) in Table 30 found no significant differences between age group means in their attitude toward computers. That is, no two groups were significantly different in their attitudes toward computers at the 0.05 alpha level.

Attitudes and Length of Teaching Experience

Table 31

Attitudes toward Computers by Length of Teaching Experience

Length(Years)	N	Attitude Mean	S.D.
0- 5	48	83.87	11.59
6-10	52	85.30	11.56
11-15	71	86.47	11.03
16-20	56	87.08	9.77
Over 20	64	83.31	11.14
Total	291	85.26	11.04

In Table 31, the attitude scores for each group by length of teaching experience are presented.

As shown by the results of the analysis of variance reported in Table 32, there are no significant differences between the group means, but a trend is evident in the results.

Table 32

Analysis of Variance: Attitudes toward Computers by Length of Teaching Experience

Source	D.F.	S.S.	M.S.	F-Ratio	F-Prob.
B.Groups	4	627.80	156.95	1.29	p=0.27
W.Groups	286	34736.34	121.45		
Total	290	35364.15			

B.Groups: Between Groups, W.Groups: Within Groups
D.F.: Degree of Freedom, S.S.: Sum of Squares
M.S.: Mean of Squares, F-Prob.: F-Probability

Scores generally increased with the amount of teaching experience, but they decreased among the most experienced group. This pattern is similar to the relationship among attitude and age, where the attitudes scores increased with age, but they declined for the oldest group (over 50).

Attitudes and Previous Training in a Computer

As reported in Table 33, the teachers who reported having received training in the use of computers ("Yes" group) showed much more favorable attitudes toward computers than did other respondents who had not received training ("No" group). The t-test indicated that there is a significant difference between the two groups.

Table 33

Attitudes toward Computers by Previous Training about Computers

Training	N	Attitude Mean	S.D.	T-Value
Yes Group	196	90.63	10.07	-4.64
No Group	95	80.88	11.7	(D.F.=289)
Total	291	85.29		

* p< 0.005

Attitudes and Actual Use of Computer Applications

Table 34

Attitudes toward Computers by Actual Use of Computers

Experiences	N	Attitude Mean	S.D.
None	37	74.27	9.87
In Class	170	89.05	9.70
Outside Class	84	82.41	10.01
Total	291	85.26	11.04

None: Never use computers
In Class: Use computers in classrooms
Outside Class: Use computers outside classrooms

The comparison of attitude mean scores among three groups by actual use of computers is presented in Table 34.

Table 35

Analysis of Variance: Attitudes toward Computers by Actual Use of Computers

Source	D.F.	S.S.	M.S.	F-Ratio	F-Prob.
B.Groups	2	7601.02	3800.51	39.42	P<0.005
W.Groups	288	27763.12	96.39		
Total	290	35364.15			

B.Groups: Between Groups, W.Groups: Within Groups
D.F.: Degree of Freedom, S.S.: Sum of Squares
M.S.: Mean of Squares, F-Prob.: F-Probability

Table 36

Significant Differences of Attitudes by Actual Use of Computers

Attitude Mean	Each Group	Grp1	Grp3	Grp2
74.2703	Grp1			
81.4167	Grp3	*		
89.0588	Grp2	*	*	

Group 1: Teachers who didn't use computers
Group 2: Teachers who used computers in their own classrooms
Group 3: Teachers who used computers outside their their classrooms
(*) denotes pairs of groups significantly different at the 0.050 level.

The three group were defined as follows: "None" included teachers who had never used computers; "In class" was made up of teachers who reported using computers in their classrooms; and "Outside class" were teachers who used computers themselves at home or in a laboratory at school, but did not use them as part of their teaching. In Table 35, the ANOVA results of the effect of using computers on mean scores for attitudes toward computers indicate that extent of use of computers had a significant effect on attitude mean responses. The F-Ratio of 39.42 was significant at the 0.05 alpha level.

As shown in Table 36, mean attitude scores of three groups were significantly different. The group of teachers who used computers in their own classrooms showed the most favorable attitudes toward computers of all three groups, and the respondents who had never used a computer had the lowest attitude mean scores. In between these two groups were teachers who used computers for themselves, but had not brought them into their classrooms and used them with students.

Attitudes and Use of Sources of Information Such as Books and Magazines about Computers

Attitude mean scores between the "Yes" group and the "No" group are presented in Table 37. The "Yes" group was teachers who consulted books or periodicals about

Table 37

Attitudes by Sources of
Information about Computers

Information	N	Attitude Mean	S.D.	T-Value
Yes Group	81	92.08	9.14	-7.55
No Group	210	82.62	10.59	(D.F.=289)
Total	291	87.35		

* p< 0.005

educational computing at least once a month. The "No" group was respondents who did not access any resources of information about educational computing at least once a month. The "Yes" group, with mean score of 92.08, showed significantly more favorable attitudes toward computers than did the "No" group, with attitude mean score of 82.62. As shown by the t-test, there is a significant difference at the 0.05 level between two groups.

Summary of Findings of the Relationships between Attitudes toward Computers and Sample Demographics

Attitudes toward computers varied with subject area taught. Mathematics teachers were the most positive, and language arts/English teachers as well as social studies/social science teachers were the least positive. As shown in Table 33, teachers who had had some training are more positive in their attitudes than those who had not had training. Users tended to be more positive than non-users, and teachers who consulted books and magazines on a regular basis were more positive than those who did not.

Relationships between Computer Literacy and Demographics

Computer Literacy and Subject Area Taught

Table 38

Computer Literacy of Teachers by Subject Area Taught

Subjects	N	Computer Literacy Mean	S.D.
L./E.	65	17.38	4.45
Math.	59	22.15	2.20
Science	59	19.59	3.55
Social	61	16.00	4.66
Business	47	20.38	2.89
Total	291	18.99	4.31

L./E.: Language Arts/English
Social: Social Studies/Social Science

Computer literacy mean scores by the subject area taught are presented in Table 38.

The analyses of variance of mean scores resulted in an F-Ratio of 25.42, supporting the conclusion of significant differences among subject area group means at the 0.005 level of probability. (See Table 39).

Table 39

Analysis of Variance: Computer Literacy of Teachers by Subject Area Taught

Source	D.F.	S.S.	M.S.	F-Ratio	F-Prob.
B.Groups	4	1415.63	353.90	25.42	p<0.005
W.Groups	286	3980.35	13.91		
Total	290	5395.98			

B.Groups: Between Groups, W.Groups: Within Groups
D.F.: Degree of Freedom, S.S.: Sum of Squares
M.S.: Mean of Squares, F-Prob.: F-Probability

Table 40

Significant Differences of Computer Literacy by Subject Areas Taught

Compter Literacy Mean	Each Group	Grp4	Grp1	Grp3	Grp5
16.00	Grp4				
17.38	Grp1	*			
19.59	Grp3	*	*		
20.38	Grp5	*	*	*	
22.15	Grp2	*	*	*	*

Com. Lit. Mean: Computer Literacy Mean Scores
Group 1: Language arts/English teachers
Group 2: Mathematics teachers, Group 3: Science teachers
Group 4: Social studies/social science teachers
Group 5: Business teachers
(*) denotes pairs of groups significantly different at the 0.050 level.

Group by group comparison of computer literacy scores is presented in Table 40. All group differences are significant, with rankings paralleling those for attitudes. Mathematics teachers as a group had the highest computer literacy scores with a mean of 22.15. Business teachers, with a mean score of 20.38, scored second to mathematics teachers with a mean score of 22.15. Science teachers, with mean score of 19.59, scored higher than social studies/social science teachers or language arts/English teachers. Language arts/English teachers, with an overall computer literacy mean score of 17.38, had a slightly higher score than did social studies/social science teachers. The social studies/ social science teachers had the lowest computer literacy mean scores, averaging 16.00.

Computer Literacy and Gender

Table 41

Computer Literacy Mean Scores by Gender

Gender	N	Com. Lit. Mean	S.D.	T-Value
Male	178	19.00	4.63	0.03
Female	113	18.98	3.77	(D.F.=289)
Total	291	18.99		

* p= 0.973

In Table 41, the computer literacy mean scores and t-value are presented for gender. Male teachers had very slightly higher scores than did female teachers. This difference is not statistically significant.

Computer Literacy and Age

Table 42

Computer Literacy Mean
Scores of Teachers by Age

Age(Years)	N	Computer Literacy Mean	S.D.
21-30	64	19.01	3.91
31-40	120	18.89	4.55
41-50	73	19.32	4.52
Over 50	34	18.99	3.76
Total	291	18.99	4.31

Table 43

Analysis of Variance: Computer
Literacy Mean Scores by Age

Source	D.F.	S.S.	M.S.	F-Ratio	F-Prob.
B.Groups	3	15.06	5.02	.26	p=.84
W.Groups	287	5380.92	18.74		
Total	290	5395.98			

B.Groups: Between Groups, W.Groups: Within Groups
D.F.: Degree of Freedom, S.S.: Sum of Squares
M.S.: Mean of Squares, F-Prob.: F-Probability

The mean computer literacy score for each of four different age groups is reported in Table 42. No trends are evident in the results. The analyses of variance in Table 43, indicate that there were no significant differences among the four age groups in their computer literacy. That is, no two groups were significantly different in computer literacy at the 0.05 alpha level.

Computer Literacy and Length of Teaching Experience

Table 44

Computer Literacy Mean Scores of Teachers by Length of Teaching Experience

Length(Years)	N	Com. Lit.Mean	S.D.
0- 5	48	18.37	4.53
6-10	52	18.61	4.36
11-15	71	19.09	4.58
16-20	56	19.91	4.07
Over 20	64	18.84	3.98
Total	291	18.99	4.31

Com. Lit. Mean: Computer literacy mean scores

The computer literacy mean scores for each of 5 groups differing in length of teaching experience show the same trends as the attitude scores. (See Table 31). As presented in Table 44, the teachers with five or fewer years of experience had the lowest scores in computer literacy, and scores increased slightly with teaching experience through the 16-20 year age group. In the over 20 year group, the most experienced group, scores were lower than the 16-20 year group although they did not score lower than the least experienced teachers.

Table 45

Analysis of Variance: Computer Literacy Mean Scores by Length of Teaching Experience

Source	D.F.	S.S.	M.S.	F-Ratio	F-Prob.
B.Groups	4	75.12	18.78	1.00	.40
W.Groups	286	5320.85	18.60		
Total	290	5395.98			

B. Groups: Between Groups, W.Groups: Within Groups
D.F.: Degree of Freedom, S.S.: Sum of Squares
M.S.: Mean of Squares, F-Prob.: F-Probability

While a trend is evident in the data, the analyses of variance of the effect of length of teaching experience on mean scores for computer literacy resulted in an F-ratio of 1.00, indicated no evidence for concluding there is a significant difference between any two group means at the 0.05 alpha level. (See Table 45).

Computer Literacy and Previous Training in a Computer

Table 46

Computer Literacy Mean Scores by Previous Training about Computers

Training	N	Mean	S.D.	T-Value
Yes	196	20.16	3.45	-6.45
No	95	16.56	4.88	(D.F.=289)
Total	291	18.36		

* p< 0.005

A summary of the computer literacy mean scores for teachers who have had previous inservice training or courses on computer use in education is presented in Table 46. Finding for computer literacy mean scores is similar to that for attitudes since the computer literacy group mean of "Yes" group had a higher mean score (20.16) than the "No" group (16.56). T-test indicated this difference was statistically significant ($p < 0.005$).

Computer Literacy and Actual Use of Applications of Computers

A summary of the computer literacy mean scores for the three groups of users is presented in Table 47.

Table 47

Computer Literacy Mean Scores
by Actual Use of Computers

Experiences	N	Com. Lit. Mean	S.D.
None	37	14.29	4.78
In Class	170	20.39	3.49
Outside Class	84	18.22	3.97
Total	291	18.9	4.31

Com. Lit. Mean: Computer literacy mean scores
None: Do not use computers
in both classrooms and outside classrooms
In Class: Use computers in classrooms
Outside Class: Use computers outside classrooms

Table 48

Analysis of Variance: Computer
Literacy by Actual Use of
Computers

Source	D.F.	S.S.	M.S.	F-Ratio	F-Prob.
B.Groups	2	1198.96	599.48	41.13	P<0.005
W.Groups	288	4197.02	14.57		
Total	290	5395.98			

B.Groups: Between Groups, W.Groups: Within Groups
D.F.: Degree of Freedom, S.S.: Sum of Squares
M.S.: Mean of Squares, F-Prob.: F-Probability

The analyses of variance, summarized in Table 48, resulted in an F-Ratio of 41.13 ($p < 0.005$), indicating that there are significant differences among the three user group in their computer literacy.

Table 49

Significant Difference of Computer Literacy Mean Scores by Actual Use of Computers

Computer Literacy Mean	Each Group	Grp1	Grp3	Grp2
14.29	Grp1			
18.22	Grp3	*		
20.39	Grp2	*	*	

Computer Literacy Mean: Computer literacy mean scores
Group 1: Teachers who do not use computers.
Group 2: Teachers who use computers in their own classrooms
Group 3: Teachers who use computers outside their classrooms
(*) denotes pairs of groups significantly different at the 0.050 level.

Comparison between computer literacy mean scores for the three user groups are presented in Table 49. The results of Table 49 show the same pattern of results as the attitude scores. (See Table 34). The group that is actually using computers in their classrooms had the highest computer literacy mean score (20.39) among the three groups. This group had the highest attitude scores also. The group of teachers who did not use computers received the lowest mean score in computer literacy (14.29), and they also scored lowest in attitudes toward computers. The group of teachers who used computers themselves but had not used them with their students, scored in between the other two groups.

Computer Literacy and Using Sources of Information Such as Books and Magazines about Computers

Table 50

Computer Literacy by Sources of Information Such as Books and Magazines about Computers

Information	N	Com. Lit. Mean	S.D.	T-Value
Yes	81	21.48	3.22	-7.40
No	210	18.08	4.30	(D.F.=289)
Total	291	19.78		

* p< 0.005

In Table 50, the "Yes" group that consulted books or periodicals about educational computing at least once a month scored significantly higher in computer literacy than the "No" group.

Relationships between Attitudes toward Computers and Computer Literacy

Attitudes toward Computers and Computer Literacy by Subject Area Taught

Analysis of both attitudes and computer literacy by subject area presented in Table 27 and Table 40, showed that subject areas taught had significant overall effects on both computer literacy and attitudes toward computers ($p < 0.005$).

Mathematics teachers as a group had the highest mean scores in both computer literacy and attitudes, while social studies/social science teachers scored the lowest mean scores on the two dependent measures.

Table 51

Relationship between Attitudes and Computer Literacy by Subject Area Taught

Subjects	N	Correlation	Significance
L./E.	65	0.4927	P<0.0005
Math.	59	0.3889	P=0.001
Science	59	0.6524	P<0.0005
Social	61	0.3024	P=0.009
Business	47	0.5156	P<0.0005
Total	291	0.5417	P<0.0005

L./E.: Language Arts/English
Social: Social Studies/Social Science

The correlation between attitudes toward computers and computer literacy for the entire sample as well as by the subject area taught is presented in Table 51. The science teacher group mean had the strongest relationships between attitudes toward computers and computer literacy. Social studies/social science teacher group mean marked the weakest relationship between the two dependent variables.

Attitudes and Computer Literacy by Gender

The t-test results of the effect of gender on mean scores for computer literacy and attitudes toward computers indicate that there are no significant differences between gender, attitude, and computer literacy. That is, although female teachers showed slightly more positive attitudes toward computers than did males, and male teachers scored a little higher in computer literacy than did females, the average scores for the two sexes were almost identical.

Table 52

Summary of Computer Literacy by Gender and Subject Area Taught

Subject areas	Male teachers N	%	Com. Lit.	Female teachers N	%	Com. Lit.	Total
L.& E.	21	32.2	17.52	44	67.7	17.36	65
Math.	41	69.5	22.66	18	30.5	20.94	59
Science	41	69.5	20.00	18	30.5	18.87	59
Social.	52	85.3	15.54	9	14.7	18.14	61
Business	23	48.9	20.13	24	51.1	20.58	47
Total	178	61.2	19.00	113	38.8	18.98	291

Com. Lit.: Computer Literacy
L.& E.: Language Arts/English, Social: Social Studies/ Social science

As shown in Table 52, the direction of the difference between males and females varies with subject area. Male teachers in mathematics and science subject areas had higher computer literacy mean scores with 22.66 and 20.00, respectively, than did their female counterparts with 20.94 and 18.87, respectively. In contrast, male respondents in social studies/ social science area scored lower than the female social studies/social science teachers. Among language arts and business teachers, the scores for male and female were almost identical. In conclusion, this study demonstrates that gender in itself did not significantly affect either attitudes toward computers or computer literacy.

Attitudes and Computer Literacy by Length of Teaching Experience

Attitude mean scores and computer literacy mean scores increased with the amount of teaching experience, but they decreased among the most experienced group. This pattern was similar to that found with age, probably because age and length of teaching experience are closely related.

From the results of the analyses by age and length of teaching experience, there is a slight suggestion that teachers who have showed the most positive attitude and who have acquired the most computer related skills are in the middle of their career. One possible conclusion is that plans for staff development will be most successful when directed to teachers with substantial experience. It may be the newest teachers, who are often seen as most receptive to new ideas, but do not have the time to develop new skills. This conclusion is very tentative, based on a slight tendency in the data, and deserves further study.

Attitudes and Computer Literacy by Previous Training in a Computer

Table 53

Relationship between Attitudes and Computer Literacy by Previous Training about Computers

	N	Correlation	Significance
No Experience	95	0.5621	P<0.005
Experience	196	0.4363	P<0.005

No Experience: "No" Group, Experience: "Yes" Group

In Tables 22, 33, and 46, the "Yes" group, those with previous computer training, had a wide range of training experiences, ranging from 2 hours inservice training to a B.A. in computer science or 5 years as a professional programmer. The earlier computer-exposed "Yes" group showed more positive attitudes toward computers and had higher scores in computer literacy. That is, the computer literacy and attitude mean scores are positively related to previous training. Most of current literature concurs.

As shown in Table 53, the correlations between attitudes and computer literacy for both the "Yes" group and the "No" group are significant. The reason that the "Yes" group's correlation is lower than that of the "No" group might be explained that the "Yes" group was composed of those who had a variety of previous training. Future research should include finer distinctions for level of training.

Attitudes and Computer Literacy by Actual Use of Applications of Computers

As presented in Table 23, two hundred and fifty four (254) teachers or 87.3% were using computers, with one hundred and seventy (170) or 58.4% using them in their classrooms and with eighty four or 28.9% using them outside their classrooms.

The two groups using computers had higher scores in both attitudes and computer literacy mean scores than did the group not using them. The group using them in their classrooms scored the highest in both attitudes and computer literacy. This group of teachers had more opportunities to use them than did the group using them outside the classrooms. It becomes evident: the more exposure to computers, the more positive attitude toward computers and the more gains in computer literacy.

Attitudes and Computer Literacy by Use of Sources of Information Such as Books and Magazines about Computers

All respondents were divided into two groups: a "Yes" group and a "No' group according to whether they used information such as books and magazines about computers at least once a month. Eighty one or 27.8% were the "Yes" group. They showed more positive attitudes toward computers and had higher computer literacy mean score than the "No" group.

Table 54

Pearson Correlation Coefficients: Attitudes and Computer Literacy by Using Sources of Information about Computers

	N	Correlation	Significance
No Information	210	0.4388	P< 0.005
Information	81	0.5893	P< 0.005

No Information: "No" Group, Information: "Yes" Group

The correlations between attitudes and computer literacy was significant for both the "Yes" and the "No" groups (Table 54).

Attitudes and Computer Literacy by the number of College Subject Area Credit hours

Table 55

Pearson Correlation Coefficients:
Attitudes and the Number of College
Subject Area Credits

College Subject Areas	Attitude toward Computers N	Correlation	Significance
Mathematics	245	0.252	P<0.0005
Business	196	0.138	P=0.026
English	253	-0.174	P=0.003
Science	249	0.141	P=0.013
Social Studies	252	-0.167	P=0.004

Table 56

Pearson Correlation Coefficients: Computer
Literacy and the Number of College Subject
Area Credits

College Subject Areas	N	Computer Literacy Correlation	Significance
Mathematics	245	0.383	P<0.0005
Business	196	0.180	P=0.006
English	253	-0.182	P=0.002
Science	249	0.172	P=0.003
Social Studies	252	-0.230	P<0.0005

The correlations between the number of college credit hours for each of the five subject areas and attitude toward computers are listed in Table 55. Also, the correlations between the number of college credit hours and computer literacy is presented in Table 56. The number of college mathematics, business, and science subject area credit hours were positively related to both attitude and computer literacy, while the number of credit hours in language arts/English and social studies/social science subject areas had a negative relationship with attitudes and computer literacy. That is, increases in the number of college mathematics, business or science credits were associated with increases in both attitudes and computer literacy. However, increases of the number of college language arts/English or social studies/social science credits were associated with decreases in attitudes and computer literacy. While all correlations were statistically significant, they were relatively weak, ranging from 0.14 to 0.25. The one exception was the relationship between credits in mathematics and computer literacy with a moderate correlation of 0.383.

Training Strategy for Staff Development

Summary of Frequency and Percent by Training Strategy

The frequency and percent of the respondents' choices for developing their computer skills are shown in Table 57. Three factors were examined.

1. Finance factor - whether computer courses or inservice training sessions are free, or whether teachers must pay for them

Table 57

Summary of Number and
Percent by Training Strategy

Training Strategy	Number and Percent Yes(N)	%	No(N)	%
* ---- Financial Factors ---- *				
Free	244	83.8	47	16.2
Own Expense	107	36.8	184	63.2
* ---- Scheduling Factors --- *				
During School	191	65.6	100	34.4
Own Time	144	49.5	147	50.5
* ---- Time Factors --------- *				
One Day Sesson	179	61.5	112	38.5
One Week Sesson	149	51.2	142	48.8
One Semester	79	27.1	212	72.9
Over a semester	25	8.6	266	91.4

* denotes that respondents could check more than one item.
Over a semester: More than one semester

2. Scheduling factor - whether training occurs during school time or on the teachers' own time

3. Length of training factor - the appropriate course or inservice training length

Finance factors were associated with free/at own expense for computer courses or inservice training sessions. Two hundred and forty four (244) or 83.8 % wanted free courses or inservices. Of these one hundred and forty seven (147) of them would participate in training if the course were free.

Scheduling factor included 'during school time/on own time'. One hundred and ninety one (191) or 65.6 % chose the option of learning during school time. One hundred and forty four (144), or 49.5%, checked that they would attend training on their own time.

In the appropriate courses or inservice training length, the length of training factor was categorized according to how many of the conditions the teachers reported were acceptable. One hundred and seventy nine (179), or 61.5%, showed learning about computers for one day. One hundred and forty nine (149), or 51.2%, would attend one week session. Seventy nine, or 27.1%, favored one semester course. Only twenty five, or 8.6%, chose more than one semester.

Relationship between Attitudes toward Computers and Training Strategy

The relationships between attitudes toward computers and training strategy were presented in Table 58.

When scores on attitudes were examined for the groups choosing each training option, all chances were affected by attitudes except for the selection of a free session. Regarding the financial factor, when training was free, there was no difference between attitude mean scores of teachers selecting the training and respondents not

Table 58

Relationship between Attitudes toward Computers and Training Strategy

Training Strategy	Yes N	Mean	S.D.	No N	Mean	S.D.	DI	T-Value D.F.=289
		* --- Financial Factors ---- *						
Free	244	85.24	11.17	47	85.36	10.47	-0.12	0.07
Own Expen.	107	87.92	10.07	184	83.71	11.31	4.21	-3.29
		* --- Scheduling Factors --- *						
School Hr.	191	85.92	10.63	100	83.99	11.72	1.93	-1.38
Own Time	144	87.00	10.76	147	83.55	11.08	3.45	-2.69
		* --- Time Factors --------- *						
One day	179	86.40	9.93	112	83.42	12.44	2.98	-2.14
One Week	149	86.53	9.91	142	83.92	12.00	2.61	-2.01
One Sem.	79	87.73	11.33	212	84.44	10.81	3.29	-2.30
Over Sem.	25	92.00	9.49	266	84.62	10.98	7.38	-3.66

* denotes that respondents could check more than one item.
DI = Mean(Yes)-Mean(No)
Own Expen.: Own expense, School Hr.: School time
One sem.: One semester, Over sem.: Over a semester

selecting it. When training was paid for by the teachers, those selecting the training had significantly higher attitude mean scores than did their counterparts.

Considering the selecting factor, teachers choosing any type of training have higher attitude scores than those not choosing the training. About two thirds (2/3) of all teachers would attend during school time compared with about half on their own time.

Examining the length of training factor, it is evident that the difference in attitude mean scores between the groups generally increased as the training became more extensive. Only teachers with very positive attitudes selected training that lasted more than one semester.

Table 59

Relationship between Training Strategy and Computer Literacy Mean Scores

Training Strategy	Computer Literacy Yes N	Mean	S.D.	No N	Mean	S.D	DI	T-Value D.F.=289
	* --- Financial Factors --- *							
Free	244	19.01	4.26	47	18.89	4.60	0.12	-0.16
Own Expen.	107	20.11	3.49	184	18.34	4.61	1.77	-3.69
	* --- Scheduling Factors --- *							
School Hr.	191	19.18	4.13	100	18.64	4.63	0.54	-0.97
Own Time	144	19.50	4.16	147	18.48	4.40	1.02	-2.02
	* --- Time factors -------- *							
One day	179	19.66	3.64	112	17.93	5.04	1.73	-3.15
One Week	149	19.72	3.57	142	18.22	4.87	1.53	-2.98
One Sem.	79	19.96	4.17	212	18.63	4.31	1.33	-2.39
Over Sem.	25	21.52	3.02	266	18.76	4.34	2.76	-4.18

* denotes that respondents could check more than one item.
DI = Mean(Yes) - Mean(No)
Own expen. = Own expense, School Hr. = During school
One Sem. = One Semester, Over Sem. = Over a semester

Relationship between Computer Literacy and Training Strategy

The relationships between training strategy and computer literacy are shown in Table 59. The pattern for the computer literacy mean score was similar to that of attitude mean scores.

For all three factors, the number of teachers choosing a training strategy decreased with the amount of time and money commitment. Especially, in time factor, the t-tests showed significant differences in both attitudes toward computers and computer literacy as a function of choice of training strategy. The difference was especially large when training was over one semester. Teachers selecting this long term training scored almost three points higher in computer literacy.

Attitude Ranking by Mean Scores

The mean rankings of the individual items in the attitudes toward computers scale for each subject area as well as the mean rating for the total group are shown in Table &part2a.. The relative ranking of the items was generally consistent across all subject areas.

In general, the respondents agreed that they are capable of learning to use a computer (item 7, Mean= 4.5326). All five groups ranked the item either first or second. The item ranked next highest across all subject matter areas is that computers will not eventually replace teachers (item 18). Teachers maybe feel that the computer can be a supplement or a tool, but not their replacement.

Table 60

Attitudes toward Computers (PART II): Ranking of Attitude items for each Subject Matter Area and the Combined Group

Items(#)	Each Group Rank LA	M	SC	SS	BU	Comb. Rank	Group Mean
I think I am capable of learning to use a computer (7).	1	1	2	1	2	1	4.5326
*Computers will (not) eventually replace teachers (18).	4	6	1	2	1	2	4.4988
Learning about computers is important (20).	2	14	4	3	6	3	4.3540
Secondary school students should learn about computers' use in society (12).	2	13	8	5	4	4	4.3368
*(Much) use should be made of computers in education (17).	5	6	6	4	7	5	4.3265
I am interested in learning more about computers (6).	6	4	10	6	4	6	4.2818
*I am (not) afraid of computers (2).	10	2	3	6	11	7	4.2471
I use or would like to use a computer with my students (8).	7	8	9	13	3	8	4.2131
I own or would like to own a computer (1).	9	8	5	10	11	9	4.1684
*Computers in every day life (don't) bother me (13).	11	10	12	14	10	10	4.0962
*Hearing others talk about computers (doesn't) make me feel uncomfortable (10).	13	3	10	18	13	11	4.0790
All secondary school students should use computers (9).	12	15	14	8	13	12	4.0790

Table 60 --- continued

I would feel comfortable working on a computer (11).	8	10	17	15	14	13	4.0550
*Computers (don't) make me feel helpless (3).	17	5	15	9	16	13	4.0550
*I (don't) feel computers control people (14).	14	18	6	11	8	15	4.0481
Computers should be used school subjects along with mathematics (15).	14	17	18	11	17	16	3.9691
*I would (not) feel nervous using a computer (5).	16	10	13	16	18	17	3.9931
*Computers (don't) dehumanize education (19).	18	16	16	16	9	18	3.9347
*I (don't) worry that my students may know more about computers than I do (16).	18	20	19	19	20	19	3.7010
I think I am confident about my ability to use and control computers (4).	20	18	20	20	19	20	3.4948
If I used a computer in the classroom, it would probably free me from boring, time consuming, and tedious chores (21).	21	21	21	21	21	21	2.7973

Comb. Rank: Combined Ranking
LA: Language arts/English teachers, M: Math. teachers
SC: Science teachers, BU: Business teachers
SS: Social studies/social science teachers
(*) denotes that the wording of these items was changed to reflect the scoring rule: "Strongly disagree=5, Disagree=4, Agree=2, and Strongly agree=1"

Table 61

Computer Literacy Topics (PART IV):
Ranking of Computer Literacy Topics for
each Subject Matter Area and the
Combined Group

Topics(#)	Each Group Rank LA	M	SC	SS	BU	Comb. Rank	Group Mean
Learn to operate a computer (9).	1	1	1	1	1	1	3.7148
Use computer programs prepared by others (19).	2	2	2	2	2	2	3.4055
Know how to organize information so a computer could use it (17).	3	3	4	2	5	3	3.2371
Determine the usefulness of given computer programs (20).	4	6	3	5	4	4	3.2337
Understand the difference between computer hardware and software (6).	9	5	7	9	3	5	3.1203
Evaluate the quality of given computer programs (21).	5	15	5	7	6	6	3.0928
Examine new applications of computers in educations (25).	6	13	6	4	7	7	3.0859
Know the major uses of computers in education (22).	7	19	7	5	11	8	2.9931
Explain what computer programs do (12).	14	7	9	9	13	9	2.9588
Learn criteria for selecting hardware (3).	8	15	10	8	12	10	2.9450
Recognize that alleged computer mistakes are usually human mistakes (30).	17	4	11	16	9	11	2.9210

Table 61 --- continued

Examine the impact of computers on society outside the educational setting (26).	17	11	15	21	8	12	2.8316
Understand the steps of computer programs (11).	14	12	13	9	20	13	2.8247
Know the major parts and functions of the hardware (2).	12	17	18	19	10	14	2.8076
Find errors in programs (14).	16	13	20	12	16	15	2.7801
Make modifications in programs (13).	12	17	16	13	23	16	2.7663
Learn about factors that limit educational uses of computers (24).	11	21	12	15	17	17	2.7560
Write programs to solve simple programs (15).	19	8	13	18	19	18	2.7423
Identify several ways that computers receive information (4).	21	9	22	19	14	19	2.6873
Examine how computers may personalize or depersonalize education (27).	10	26	17	21	22	20	2.6564
Learn how computers can assist in decision making through data query systems or artificial intelligence-based systems (29).	23	24	24	14	17	21	2.5979
Understand why computers need programs (18).	24	9	18	26	15	22	2.5773
Learn about different programming languages useful for school curriculum such as PASCAL, LOGO, PILOT and so on (23).	21	21	21	16	25	23	2.5670

Table 61 --- continued

Consider whether the use of computers (to assist in student learning) causes the teachers to lose control of the teaching process (28).	20	27	23	23	23	24	2.4433
Explain what a computer algorithm is (10).	27	20	25	24	27	25	2.3058
Know how computers store information (16).	25	21	26	27	21	26	2.3024
Understand how a computer processes information (5).	26	25	27	25	26	27	2.2474
Learn how the human brain and a computer are alike and are different (8).	28	29	28	28	28	28	1.9313
Learn what happens inside a computer when it operates (1).	29	28	29	29	30	29	1.7698
Learn the history of computers (7).	30	30	30	30	29	30	1.6357

Comb. Rank: Combined Ranking
LA: Language arts/English, M: Mathematics, SC: Science, and SS: Social studies/Social science

Attitudes items ranked the lowest by the teachers are also of interest. Although two hundred and fifty four (254), or 87.3 %, among all respondents were using computers (Table 23), they did not think that they were confident about their abilities to use and control computers (item 4). They ranked it second from the last.

The lowest ranked item for all groups was "If I used a computer in the classroom, it would probably free me from boring, time consuming, and tedious chores (21)". While many advocates of computers stress their use in freeing up time for thinking, reasoning, and problem solving, it seems this result is not appreciated by teachers.

There were some differences related to subject areas. Five items concerned with feelings about computers (2, 3, 5, 10 and 11), like "I would feel comfortable working on a computer"(11) and "I am (not) afraid of computers" (2), were ranked higher by mathematics teachers. The findings on computer literacy showed that mathematics teachers were more familiar with computers than the other groups of teachers. This level of expertise may be necessary before teachers are comfortable. The mathematics teachers also assigned relatively low ratings to general computer literacy goals-such as "Learning about computers is important" (20) and

"Secondary school students should learn about the computers' use in society" (12). Mathematics teachers were less interested in placing computer use in a social context.

Business teachers disagreeed with the item "Computers dehumanize education" (19) more than the other groups of teachers. The applications of computers in business education place more emphasis on word processing, accounting, and so on. In business the computer can be considered to be an important tool to help better their lives. Perhaps, that is why business teachers did not agree that computers dehumanize education.

Social studies/social science teachers have an interesting patern of responses. They agreed that "Learning about computer is important" (20), and that "Secondary school students should learn about computers in society" (12), and that "Use should be made of computers in education" (17). However, they were relatively low in their response to "I use or would like to use a computer with my students" (8). It seems that social studies/social science teachers feel computers are important in other classrooms.

Topics for Computer Literacy

Topics Ranking by Mean Scores

Ranking by importance of computer topics in teaching or learning about or with computers is shown in Table 61. The items are listed in order of average rating across all groups from most important to least important. In addition, the relative ranking within each subject area is presented.

Teachers were asked to rate the importance of each of the items by circling the number that best agreed with them (Apendix A) from the following responses: not important (1), somewhat important (2), important (3), and very important (4). The mean rating for each of all computer literacy topics was computed to determine the degree of importance by the teachers.

As a whole, the respondents perceived as more important those topics that involved actual applications of computers. Items about how to use computers (9, 19, and 17) were rated the highest. The second highest ratings (6, 20, 21, 22, and 25) were for topics about understanding and selecting software. Topics related to learning the internal working of a computer (1, 5, 8, 10, and 16) such as "Understanding how a computer processes information" and "Learn what happens inside a computer when it operates" were rated lowest across all groups of teachers.

Some differences among rankings were evident among subject areas. Mathematics teachers as a group, with the most favorable attitudes toward computers and the highest computer literacy mean scores, ranked items related to computer based instruction (21, 25, and 22) lower than teachers in other subject areas. They rated items about programming and programming errors (12, 14, 15, 18 and 30) more important than teachers in other subject matter areas. This pattern may reflect fundamental characteristics of how computers are used in mathematics. Many mathematics teachers teach programming, and emphasize how to write programs. Their interest is in refining understanding of mathematical principles through programming rather than using instructional programs to illustrate a concept or provide practice with a skill.

Another apparent difference linked to subject areas is the business teachers' relatively high rating of topic 26: Examine the impact of computers on society outside the educational setting. Perhaps this occurred because the business subject area can be said to be directed toward an actual society. The place of computers in the business curriculum is influnced primarily by the place of computers in the business community.

Social studies/social science teachers also gave relatively high ratings of topic 26 concerning the impact of computers on society. They were also particularly interested in learning about computers. It can assist in decision making through data query systems or artificial intelligence-based systems (29). Social studies/social science teachers were also interested in "make modifications in programs" (13). Perhaps they are not satisfied with currently available software, but they felt that with slight modifications it would be more useful. One unexpected result was that social studies/social science teachers were lowest in their response to "Examine the impact of computers on society outside the educational setting".

Language arts/English teachers were relatively more interested in limitations of computers in education (topics 24 and 27) and were relatively less interested in learning about what computer programs do (6, 12, and 30).

Summary

This study was designed to determine the relationships between teachers' attitudes toward computers and their level of computer literacy. In addition, issues about the scheduling and content of an inservice computer literacy curriculum for secondary school teachers were explored.

Thirty six (36) out of thirty nine (39) school districts in AEA 10 of Iowa agreed to participate in the study. Each school district had one secondary school. Questionnaires distributed to teachers from 5 subject matter areas: language arts/English, mathematics, science, social studies/social science, and business. Ninety two (92)%, or two hundred and ninety one of the selected subject area teachers returned usable questionnaires.

Data were analized using SPSSx at the Weeg Computing Center of the University of Iowa.

There were significant differences on mean scores for attitudes and computer literacy between the subject areas taught. That is, the subject areas taught had a significant effect on the computer literacy and attitude mean responses with F being significant at the 0.05 alpha level.

Gender, age, and length of teaching experience did not have a significant effect on computer literacy and attitude mean responses at the 0.05 alpha level.

Previous training about computers, actual use of computers, and using information about computers were found to significantly affect attitude and computer literacy.

The correlations between the number of college subject area credit hours and attitudes toward computers, as well as the correlations between credit hours and computer literacy were found to be statistically significant although their relationships were relatively weak. Credit hours in mathematics, business, and science were positively related to attitudes and computer literacy, and credit hours in language arts and social science were negatively related.

For the entire sample, the attitudes toward computers were significantly related to computer literacy with r=0.5416. The relationship between computer literacy and attitudes toward computers varied with the subject areas taught. Science teachers had the strongest relationship between attitudes toward computers and computer literacy among the five subject areas. The social studies/social science teacher group had the weakest relationship between the two variables.

In identifying appropriate training strategy for developing computer skills, three factors were examined: (1) finance factor, (2) scheduling factor, and (3) length of training factor. As a whole, teachers primarily chose "a free session of one day during school time". Differences in both attitude mean scores and computer literacy mean scores between the groups generally increased as the training became more extensive. Only teachers with very positive attitudes and higher computer literacy mean scores selected training that lasted more than one semester. For all three factors, the number of respondents choosing a training strategy decreased with the amount of time and financial committment.

Responses to the attitude scale indicated that, as a whole, respondents agreed that secondary school students should learn about computers. Two hundred and fifty four, or 87.3%, among all respondents were using computers in schools or outside schools. But they did not think that they were confident about their ability to use and control computers.

There were general agreement across subject areas about topics for a computer literacy course. The respondents, on the whole, assigned the highest ratings to topics that related to actual applications of computers. They assigned the lowest ratings to items concerned with learning about the internal working of computers (topics 1, 5, 8, 10, and 16).

Some subject matter differences in relative importance of topics was evident. Mathematics teachers considered as more important the items for programming skills and programming errors. Business teachers were interested in examining the impact of computers on society (26) but social studies/ social science teachers rated this item low.

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATION

Introduction

This chapter is composed of three sections. In the first, the design and results are summarized. The second section presents the conclusions as related to the review of the literature. The final part consists of recommendations for future research.

Summary

The purpose of this study was to determine relationships between attitudes toward computers and the level of skills in educational computing among secondary school teachers in mathematics, business, science, social studies/social science, and language arts/English. In addition, strategies for effective training and topics for a computer literacy curriculum were explored.

Statement of the Problem

What were the relationships between computer literacy, attitudes toward computers, and the topics and skills identifed as components of computer literacy in the education of secondary school teachers?

Specific Questions which were Studied:

1. Was there a relationship between the selected demographic characteristics, computer literacy, and the attitudes toward computers of secondary school teachers?

   Selected demographic characteristics included:

   a) Subject area taught
   b) Gender
   c) Age
   d) Length of teaching experience,
   e) Previous training
   f) Actual use of computers
   g) Using sources of information
   h) Number of college subject area credit hours

2. What strategies for teacher training in computer literacy were preferred by secondary school teachers?

   a) Was the choice of strategy related to the teachers' attitudes toward computers?
   b) Was the choice of strategy related to the teachers' computer literacy?

3. Which topics and skills in computer literacy were chosen as important by secondary school teachers?

   a) Which topics and skills were chosen as most important by secondary school teachers?

b) Which topics and skills were selected as most important within subject areas taught?

This study investigated the above questions.

Methods and Procedure

The population of this study consisted of secondary school teachers (grades 9 to 12) of AEA 10, one of sixteen AEAs in Iowa. This study focused on teachers in 5 disciplines- language arts/English, mathematics, science, social studies/social science, and business.

Letters were sent to the thirty nine (39) school district superintendents to request their participation in this study. Thirty six (36) districts agreed to participate in this study. Three districts declined to participate in this study because they had recently participated in other survey research.

Each high school principal was then contacted through letters and telephone calls. The purpose of the study was explained, and principals were asked to report the number of teachers they had in each of the selected subject areas.

Preliminary plans were to select two (2) language arts/English teachers, two (2) mathematics teachers, two (2) science teachers, two (2) social studies/ social science teachers, and two (2) business teachers from each school. However, this plan was modified based on the high school principals' reports. Some high shools had only one teacher in a particular subject area. In this case that single individual was included in the sample. If there were no teachers in one of the five subject areas, the area was not included in the sample from that school.

The survey instrument consisted of four sections. (See Appendix A). The first part was for gathering demographic information about individual teachers. It also included items related to preferences about computer training strategy. Part II was created to measure teachers' attitudes toward computers. The inventory was composed of three domains: using computers (4 items), feelings about computers (10 items), and computers in education (7 items).

Survey instruments and instructions were mailed to the thirty six (36) high school principals. They were asked to assist in the selection of their members from the five subject areas and to collect and send the survey questionnaires back to the researcher.

According to the principals' reports, the sample size from the five subject areas was three hundred and seventeen (317). The return rate for usable questionnaires was 92% or two hundred and ninety one (291) teachers.

As presented in Table 17 and Table 18, the subject areas were fairly evenly represented, with about 20% of all respondents in each. Sixty five or 22.2% were language arts/English teachers; fifty nine or 20.3%, mathematics teachers; fifty nine or 20.3%, science teachers; sixty one or 21.0%, social studies/social science teachers; and forty seven or 16.2%, business teachers.

Analysis of the data was conducted using the SPSSx (Statistical Package for Social Sciences) which was available at the Weeg Computing Center of The University of Iowa under the IBM 3350-Wylbur system.

Scores for attitudes based on the Likert type scale were computed by summing the ratings assigned to each item. When items were scored, "5" always signified greater acceptance of computers (Slavin, 1984). For example, item 19 ("Computers dehumanize education.") was scored in the reverse manner, with "strongly disagree" being given a score of "5". Mean attitude scores for each group were provided through SPSSx. Computer literacy scores were computed by counting the number of correct answers to the 25 items.

Statistical procedures to examine the specific questions included frequency distributions, t-tests, one-way analysis of variance, and Pearson correlation coefficients. Demographics were simple frequency counts of information provided by teachers. The t-values and F-scores were used to test for significance of differences on the mean scores for attitudes and computer literacy with the significance established at the 0.05 alpha level.

Summary of Findings

A summary of findings is presented in relation to specific questions listed as substatements of "Statement of the Problem".

1. Was there a relationship between the selected demographic characteristics, computer literacy, and attitudes toward computers of secondary school teachers?

   The answers to this question was sometimes yes and sometimes no. The detailed answers are as follows.

   a) Was there a relationship between subject area taught, computer literacy, and attitudes toward computers?

      The answer was "yes". The ANOVA tests showed significant differences between the five subject matter areas in both attitudes and computer literacy. Mathematics teachers showed the most favorable attitudes toward computers (90.25), and received the highest computer literacy mean score (22.15) among the five subject matter groups. In comparison, language arts/English and social studies/social science teachers had lower mean scores in both variables. Language arts/English teachers averaged 81.26 in attitudes and 17.38 in computer literacy, and Social studies/social science teachers scored the lowest on both variables with 81.06 and 16.10, respectively.

b) Was there a relationship between gender, computer literacy, and attitudes toward computers of secondary school teachers?

The answer was "no". Though females showed slightly more positive attitudes toward computers, and males scored slightly higher in computer literacy than did their counterparts, there were no significant differences on mean scores for attitudes and computer literacy between males and females.

c) Was there a relationship between age, computer literacy, and attitudes toward computers of secondary school teachers?

The answer was "no". Respondents were grouped into 4 categories: 21-30; 31-40; 41-50 and over 50. Both attitude mean scores and computer literacy mean scores increased across the first 3 age groups. However, in the over 50 group, the mean scores were the lowest among the 4 age groups. In spite of this trend, the ANOVA showed no significant differences between age groups for their attitudes toward computers and computer literacy.

d) Was there a relationship between length of teaching experience, computer literacy, and attitudes toward applications of computers in education of secondary school teachers?

The answer was "no". In both attitude mean score and computer literacy mean score, scores generally increased with the amount of teaching experience, but they decreased among the most experienced group. This result was similar to the finding for age. According to the analyses, there were no statistically significant differences on mean scores for attitudes toward computers or computer literacy as a function of length of teaching experience.

e) Was there a relationship between previous training in a computer, computer literacy, and attitudes toward computers?

The answer was "yes". The t-test of significance of the effects of previous training about computers on mean scores for computer literacy and attitude showed that previous traning about computers was significantly related to attitude and computer literacy. That is, the teachers who reported having received training in the use of computers showed much more favorable attitudes toward computers (87.38) and scored much higher computer literacy mean scores (20.16) than did their counterparts who averaged 80.88 and 16.56, respectively.

f) Was there a relationship between actual use of educational applications of computers, computer literacy, and attitude toward computers?

The answer was "yes". The ANOVA tests showed that ways in which teachers used computers significantly affected attitude and computer literacy. That is, teachers who used computers in their own classrooms showed the most favorable attitude toward computers (89.65), and had the highest computer literacy mean score (20.39) among all three groups. The respondents not using computers had the lowest mean scores of two variables with 74.27 and 14.29, respectively. In addition, teachers who used computers themselves, but did not bring them into the classrooms to use with students, fell in between the classroom users and the non-user, with an attitude mean score of 82.49 and a computer literacy mean score of 18.22. Differences between all 3 groups were statistically significant.

g) Was there a relationship between using any sources of information about computers, computer literacy, and attitudes toward computers?

The answer was "yes". The t-test of the effect of information about computers was significant for both computer literacy and attitude about computers. The group using sources of information such as books and magazines about computers at least once a month showed much more favorable attitudes toward computers (92.08) and had a higher computer literacy mean score (21.48) than did its counterpart with mean scores of 82.62 and 18.08, respectively.

h) Was there a relationship between the number of college subject area credit hours, computer literacy, and attitudes toward computers?

The answer was "yes". The relationships between the number of college subject area credit hours, attitudes toward computers, and computer literacy were statistically significant although they were relatively weak. The number of college mathematics, business, and science subject area credit hours had positive relationships with both attitude and computer literacy. In contrast, those of language arts/English and social studies/social science subject areas had a negative relationship with both attitude and computer literacy.

i) Was there a relationship between computer literacy and attitudes toward computers of secondary school teachers?

The answer was "yes". The correlation between attitudes and computer literacy for the entire sample was 0.5416.

j) Did the relationship between computer literacy and attitudes toward computers vary with the subject area taught?

The answer was "yes". The magnitude of the correlations varied with subject matter area. The science teacher group had the strongest relationship between attitude and computer literacy among all respondent groups (r= 0.6524). Social studies/social science teacher group marked the weakest relationship (r=0.3024). The business teacher group had r= 0.5156; mathematics teachers, r= 0.3889; and language arts/English, r= 0.4927, respectively.

2. What strategies for teacher training in computer literacy were preferred by secondary school teachers?

The training strategy preferred by most teachers for developing computer skills was "a free session of one day during school time". Three factors were considered in identifying the training strategy: (1) financial factor, (2) scheduling factor, and (3) time factor.

a) Was the choices of strategy related to the teachers' attitudes toward computers?

The answer was "yes". (See answer to part b).

b) Was the choice of strategy related to the teachers' computer literacy?

The answer was "yes".

The more extensive the training, the larger the differences in both attitude mean scores and computer literacy mean scores between teachers choosing the training option and those not choosing it. Only teachers with very high scores in attitude and computer literacy chose training that lasted more than one semester.

3. Across all subject matter areas, which topics and skills in computer literacy were chosen as most important?

a) Which topics and skills were chosen as most important by secondary school teachers?

On the whole, the teachers emphasized actual applications of computers. They ranked highest the topics (9, 19, and 17) related to first hand operation of computers. Most important to them were hands-on skills rather than demonstration of how others use computers. Items related to software selection and evaluation (topics 6, 20, 21, 22 and 25) were ranked second highest. Teachers were interested in exploring a variety of applications, and being informed of new developments. Teachers generally were not interested topics (1, 5, 8, 10 and 16) related to how the computers actually works. These items were ranked the lowest by the teachers.

b) Which topics and skills were selected as most important within subject areas taught?

Mathematics teachers perceived as more important those topics that involved programming skills and programming errors (12, 14, 15, 18 and 30).

The topic of the social impact of computers(26) was chosen as more imporant by the business teachers and as less important by social studies/social science teachers.

Conclusion

In the following section of the chapter, topics from review of the literature presented in Chapter II are examined on the basis of the results of the data analyses.

Rogers (1983) said that through the innovation decision process, an individual passes from the first knowledge of an innovation, to forming an attitude toward the innovation, to deciding to reject or accept, to implementing the innovation, and to confirming this decision.

As seen in Table 62, without exception, all respondents reported having computers in their schools. According to Johnston (1985), although data were from the nation's middle schools (generally 6-8) and junior high schools (generally 7-9), in the spring of 1984 more than two-thirds (2/3) of the above schools have at least one microcomputer. The high schools in the AEA 10 of Iowa possess at least two computers in their schools. In fact, the average number of computers is 15.8.

Lockheed (1984) noted that in the spring of 1982 66% of the nation's secondary schools reported using microcomputers. Now, 100% of the secondary schools of the AEA 10 in Iowa have computers. This also means that all respondents of this study had at least visual, physical, and indirect contact with computers. They were already exposed to computers, and passed Rogers' the first step of the five

Table 62

Number of Computers Used in Each
High School of AEA 10 in Iowa

School N=36	Number of Compuer	Cumulative # of Comp.	School N=36	Number of Computers	Cumulative # of Comp.
1	18	18	19	25	314
2	6	24	20	12	326
3	25	49	21	19	345
4	15	64	22	34	379
5	38	102	23	14	393
6	11	113	24	12	405
7	16	129	25	15	420
8	16	145	26	5	425
9	5	150	27	8	433
10	2	152	28	15	448
11	7	159	29	14	462
12	13	172	30	9	471
13	18	190	31	15	486
14	15	205	32	5	491
15	33	238	33	19	510
16	30	268	34	17	527
17	11	279	35	15	542
18	10	289	36	26	568

# of Comp.: Number of computers
Total number of computers: 568
Average number of computers: 15.8

stages of innovation decision process. Forming an attitude toward computers and deciding to accept them, two hundred fifty four (254), or 87.3%, of all respondents were using computers. That is, they were implementing innovations. To some of them, the innovation decision process could already be terminated if computers were proved to be advantageous, to easily be used, and to be routinized. Some people may be seeking reinforcement for the innovation decision already made.

However, computer technology does not completely fit this innovation adoption model. "Computer applications in education" include many individual innovations, and developments in hardware and software can be considered to be new innovations. Therefore, use of computer technology requires ongoing innovation decision processes.

An innovation can be evaluated according to such adopter characteristics as gender, age, past experience, personality, social factor, or other factors. In this study, the innovation called computer literacy was examined by gender, age, length of teaching experience, and other educational factors.

Under the comprehensive review of literature, gender, age, professional experiences, and other educational factors were often related to attitudes and computer literacy. This study showed that gender, age, and professional experiences did not have significant effects on mean scores for attitudes and computer literacy. Why were not gender, age, and professional experience related to gains, and why were subject area taught related to gains on attitudes toward computers and computer literacy in this study?

A study conducted by Lockheed et al. (1984) found that gender differences of secondary school students resulted from a lack of access to use of computers and motivation. Female students did not score higher in computer literacy than male students. They had a tendency to avoid operating complicated-looking equipment or solving complex problems.

Bradford (1984) presented data showing that overall mean scores for both attitudes and computer literacy of school board members, administrators, and teachers (grades 7 to 8) were significantly related to sex, age, and professional experience variables. But in his study, gender differences among teachers alone in attitudes and computer literacy were not consistently found.

Maybe past findings of gender differences reflected subject area related differences. Differences in mathematics achievement are well known. Perhaps as computers move out of mathematics departments and have more general applications in a variety of disciplines, gender differences will diminish.

There is a possible explanation for the lack of effect for gender, age, and professional experiences on attitudes and computer literacy. Most of the teachers completed their educational training before the importance of computers was identified in educational settings. Littman (1980) pointed out as follows.

> ---During the formal learning periods of the majority of teachers these modern information technologies did not exist, and no effort has been made to bring this knowledge to them (p. 174).

Although the situation is changing in that the number of colleges offering computer literacy programs for teachers and future teachers is increasing, relatively few colleges have instituted such programs. Therefore, teachers were unable to use computers during their college days. They started their professional experiences without prior knowledge about computers. The concepts about computers and the need for computer literacy are relatively new ideas to most teachers (Milner, 1980; Moursound, 1982; Benderson, 1983; Williams, 1983). But during the past few years, the introduction of computers to each school district has been increasing across the country. The teachers have been abruptly exposed to computers regardless of gender, age, and professional experiences.

This increasing rate of introduction has brought discrepancy among subject matter areas rather than gender, age, and professional experiences. First of all, the responsibility for teaching students computer literacy has fallen on mathematics teachers. The first applications for computers involved solving mathematical problems.

Science teachers have had to learn how to use computers for scientific demonstrations, tutorials, data analyses, and simulations.

Also, business teachers must teach students accounting, word processing, and other business applications by using computers. Therefore, greater access and more use of computers have influenced the differences on mean scores for attitudes toward computers and computer literacy among subject area groups. Bradford (1984) also concurs. In other words, the factors which influence attitudes toward computers and computer literacy are not gender, age, and length of teaching experience, but subject matter areas taught.

Why was the previous access to computers, the actual use of computers, and the access to information about computers related to gains on attitudes toward computers and computer literacy?

Those who received previous training about computers can be said to have been exposed to computers earlier than others not having any training. The popular literature is full of statements that the amount of computer exposure was significantly related to the two variables - attitudes and computer literacy. Thus, it is logical that the respondents with prior experience of computers showed more positive attitudes toward computers and had higher scores in computer literacy than their counterparts.

As for the actual use of computers, all respondents were divided into three groups- (1) those who did not use computers, (2) teachers who used them in their classrooms, and (3) those who utilized them outside their classrooms.

This study noted that the access to computers outside school was only modestly related to attitudes and computer literacy gains compared to the access to them in classrooms. This may have been due to the nature of learning environments. The classroom provides a rich learning environment for teachers as well as for students. Teachers get interaction and feedback from their students when working with computers in their classrooms. They observe students' various activities and respond to a wide variety of problems. Students serve as resouces in suggesting and testing various ideas for solving the problems. When computers are in classrooms, teachers have greater access and more contact with them. Such experience may account for the high scores in attitudes and computer literacy among teachers using computers in their classrooms.

Access to a computer outside of school would not serve as a substitute for it in the classroom. For example, a home computer would not provide the rich context with extensive interaction or the variety of experiences that classroom computers provide.

Those using sources of information about computers at least once a month can be said to be much more interested in computers. Computer exposure also includes reading about computers. Therefore, it is quite natural that the more exposure, the more gains on attitudes and computer literacy.

The number of college credit hours in each subject area was presented in Table 55. As the number of college mathematics, business, and science subject matter credit hours increased, attitude and computer literacy scores also increased. But in language arts/English and Social studies/social science, it was the reverse, with an increase in credit hours, attitude and computer literacy scores decreased.

The possible explanation can be suggested as follows: According to some literature, knowledge of computers was considered as positively related to knowledge of mathematics. That is, those who have little mathematics background might have trouble in learning about computers or might feel less enthusiastic in practicing them. This study supported the opinion that mathematics has a positive relationship with computer technology. In addition, the subject areas of business and science use more mathematical concepts than language arts/English and social studies/social science areas for developing their fields.

One recommendation is that for staff development of language arts/ English and social studies/social science subjects, a non-mathematical approach would be more effective in computer literacy training than a mathematical approach, especially, teaching about computer programming. This could be done by requiring an emphasis on flowcharting rather than directly introducing the instructions of a programming language: the direct approach requires a strong mathematical background needed to understand the programming examples.

Results from the attitude survey indicate teachers have a positive attitude toward using computers. The teachers strongly agreed that they are capable of learning to use a computer (item 7), that learning about computers is important (item 20), that secondary school students should learn about the computers' use in society (item 20), and that much use should be made of computers in education (item 17). (See Table 60). Most teachers in this study have had some computer training. One hundred and ninety six (196), or 67.4%, of all respondents received previous training about computers. (See Table 22). In addition, even more of them directly use computers. Two hundred and fifty four (254) or 87.3% of them reported using computers for a variety of purposes. (See Table 23). This is an informed and experienced group. Their top rated attitude items showed that they overwhelmingly agreed schools should have a responsibility to prepare students to participate in a computer oriented society.

Despite their training, the majority of teachers reported that they are not confident about their ability to use and control computers (PART II, item 4). (See Table

60). This item was the second lowest on the attitude scale. Teachers seem to feel that they need more training before they will be comfortable with computer technology. The lowest ranked item indicated teachers did not expect that "If teachers used a computer in the classroom, it would probably free them from boring, time consuming, and tedious chores" (item 21) (Baker, 1975; Joos, 1980; Mclsaac and Baker, 1981; Bitter and Camuse, 1985; Gustafson, 1985; Riedesel and Clements, 1985). This finding contradicts much of the popular literature. This result may indicate that teachers have not learned to use many of the clerical applications available for computers.

The results of the attitude questionnaire seem to contradict the teachers response to the training strategy they preferred. While they agreed computers are useful in education (item 17) and that they are interested in learning more about computers (items 6), they were not willing to commit their own resources to learn more about computers in their own professional lives. The overwhelmingly preferred training strategy was "one day free session during school time". This is a very minimal committment to learning about computers. This might indicate that although computers are viewed as very useful for solving problems in the society, the educational usefulness of computers may not be appreciated, because the teachers still do not know how to incorporate computer technology in their own professional areas.

What topics should be included in an effective computer literacy program for teachers? The computer literacy topics that the respondents perceived as most important were those related to operating computers and those concerned with selecting, evaluating and using software. Of first importance was actually using the computers- turning it on, booting a disk and using software prepared by others. The majority of the respondents had training about computers (67.4%) (Table 22) and were using computers either in their classrooms or outside of classrooms (87.3%) (Table 23). The high ratings for these items might be due to their own experiences. Teachers were particularly interested in direct use of computers.

Teachers were also very interested in learning about software directly related to students' learning as well as applications for record keeping in their professional tasks. Popular literature concurs that appropriate use of computers will help free teachers from various chores in a school. The skilled user of computers ought to be able to evaluate and use a wide variety of software. Teachers did not agree that computers could help them out of boring chores (PART II, item 21). This result might indicate that teachers lack ability to evalute record keeping software and to use it in educational settings. Familiarity with a range of software and evaluative criteria for software should be considered as an important component of a computer literacy curriculum.

The teachers were not interested in learning how computers work. Some authors propose that a computer literacy program start from the awareness of the impact of computers on society, or understanding how a computer works internally, or the history of computers. Components of computer literacy, that is, suggested basic elements were presented in Table 1. Only two, or 9%, of twenty three (23) authors did not include the history of computers. However, the results of this study showed that teachers wanted to learn how to use hardware and software rather than how it works or learning about the history of computers. This finding is supported by Hoth (1985). She studied inservice training for faculty of The Central University of Florida and concluded that the social impact of computers and the history of computers did not need to be included in an effective computer literacy program for faculty.

While the generic skills apply to all subject matter areas, teachers need to be familiar with software designed for their teaching areas. Providing demonstrations of science software for language arts/English teachers may not have much effect in developing their appreciation of educational applications of computers.

Strong subject matter differences were found for both attitude toward computers (PART II) and computer literacy (PART III). As shown in the result of this study, a computer has a different role in a different displine.

In summary, the research conducted here indicates the following design for inservice computer literacy program for secondary school teachers.

Suggestions for General Design of Computer Literacy Curriculum

There are two main emphases in the design of this computer literacy program. First, the program should provide opportunities to teachers to use and control computers themselves (PART IV, topic 9) and to learn how to use software packages (PART IV, topic 19). (See Table 61). The second is to learn about software (16) including major types of software (22), new development (25), and criteria for evaluating software. (See Table 61).

1. What skills are included in the program?

Teachers did not primarily want to learn about internal working of computers (PART IV, topics 1, 5, 8, 10 and 16) or the history of computers (topic 7). (See Table 61).

The majority of respondents (87.3%) were using computers(Table 23) and most teachers (67.4%) had previous training about computers. (See Table 22). However, they felt that they were not confident in using and controling computers (PART II, item 4). (See Table 60). This suggested that using a computer in classrooms requires ongoing staff development for being familiar with new applications of computers.

2. Refinements for the Individual Subject Areas

a) Mathematics:

Mathematics teachers may consider a computer as a kind of calculating machine. They felt that students should understand programs and be able to write programs. (PART IV, topics 12, 30, 15, 4, and 9). (See Table 61). They were relatively less interested in software (topic 19) and hardware (topic 3). They considered as more important the topics related to programming (topic 15) and understanding programming errors (topic 30). (See Table 61).

b) Business

Business teachers may view computers as part of the business world (PART II, item 1). (See Table 60). They wanted their students to know common business applications of computers (PART II, item 12). (See Table 60).

c) Science

Computers are used to collect and analyze data, and to provide simulations to test hypothesis. Therefore, they may perceive that a computer is a valuable tool for themselves (PART II, item 1).

d) Language arts/English and social studies/social science

Teachers in these areas may not have a sense of possible applications of computers to their subject areas. Compared to other disciplines, these teachers were more interested in knowing major uses of computers. Perhaps they are not satisfied with what is currently available (PART IV, topic 13). Social studies teachers were particularly interested in research using data query systems of computers (PART IV, topic 29). Therefore, in order to help them learn more about computers, there should be workshops that have examples of software for their disciplines.

That gives some suggestions for how to plan training program for teachers from different subject areas.

Recommendations

On the basis of the results of this study, these recommendations for further study are made:

1. Future studies of attitudes should examine the teachers' attitudes toward using computers in his or

her own classroom in addition to assessing the teachers general attitude toward the broad concept of computers in education.

2. What specific skills do teachers need to use computers in their classrooms? After they become familiar with operating a computer, is it a natural progression to using it with their students, or are additional skills needed?
3. While computers can be used throughout the curriculum the applications are quite different for different subject areas. One direction for future research is to identify both similarities and differences among softwares for the different subject matter areas.
4. Even teachers who scored high in computer literacy want to know more about computers- What kinds of staff development programs will help them to learn about new developments?
5. Teachers are willing to learn about computer applications during school time- How can districts provide training opportunities during the school day?

APPENDIX A

SURVEY ITEMS

COMPUTER LITERACY APPLICATIONS SURVEY

PART I

Directions: For each question in this section check the response that best describes you.

---

1. Type of position held:

__ 1. Teacher
__ 2. Other____________________
(Specify) 2. Sex:

__ 1. Male
__ 2. Female

3. Years of teaching experience(including current school year)
__ 1. 0 - 5
__ 2. 6 - 10
__ 3. 11 - 15
__ 4. 16 - 20
__ 5. Over 20

4. (Approximate) the number of college credits in the following areas studied.

_____ 1. College credits in mathematics courses taken
_____ 2. College credits in business courses taken
_____ 3. College credits in English courses taken
_____ 4. College credits in science courses taken
_____ 5. College credits in social studies/social science courses taken

5. Subject Area Taught:

__ 1. Language Arts/English
__ 2. Mathematics
__ 3. Science
__ 4. Social Studies/Social Science
__ 5. Business
__ 6. Other_________________________
(Specify)

6. Have you ever received training about computers or computer use in education ?

__ 1. No.
__ 2. Yes. ____
(Specify)

7. Have you ever used a computer ?

__ 1. No.
__ 2. Yes. I have used a computer in my own classroom. (Please describe)

__ 3. Yes. But not in my own classroom (please describe).

8. Age range:

__ 1. 21 - 30
__ 2. 31 - 40
__ 3. 41 - 50
__ 4. 51 - 60
__ 5. Over 60

9. Do you use any sources of information such as magazines, books, and so on about computing at least once a month ?

__ 1. No.
__ 2. Yes. ______________________ (Specify)

10. How many single-user microcomputers and computer terminals do you have in your school?

___ 1. The number of single-user microcomputers
___ 2. The number of terminals
___ 3. Total

11. If you take or were to take some computer courses or inservice training session, please indicate under what conditions you would most readily take computer courses. Check all answers that apply.

__ 1.Free
__ 2.At your own expense
__ 3.During school hours and you were released from your class
__ 4.On your own time
__ 5.On one day session
__ 6.A week-long session
__ 7.A semester-long college course
__ 8.More than one semester-long college course

PART II

Directions: There are various attitudes toward computers. Please indicate your feelings about computers to the following items by circling the number that best agrees with you.

1 = Strongly Disagree
2 = Disagree
3 = Undecided
4 = Agree
5 = Strongly agree

1.	I own or would like to own a computer.---	1	2	3	4	5
2.	I am afraid of computers. ---------------	1	2	3	4	5
3.	Computers make me feel helpless. --------	1	2	3	4	5
4.	I think I am confident about my ability to use and control computers. -----------	1	2	3	4	5
5.	I would feel nervous using a computer. --	1	2	3	4	5
6.	I am interested in learning more about using computers. ------------------	1	2	3	4	5
7.	I think I am capable of learning to use a computer. ----------------------	1	2	3	4	5
8.	I use or would like to use a computer with my students. -----------------------	1	2	3	4	5
9.	All secondary school students should use computers. --------------------------	1	2	3	4	5
10.	Hearing others talk about computers makes me feel uncomfortable. ------------	1	2	3	4	5
11.	I would feel comfortable working on a computer.------------------------------	1	2	3	4	5
12.	Secondary school students should learn about the computers's use in society.----	1	2	3	4	5

13. Computers in every day life bother me.---	1	2	3	4	5
14. I feel computers control people. --------	1	2	3	4	5
15. Computers should be used in school subjects along with math. ---------------	1	2	3	4	5
16. I worry that my students may know more about computers than I do. --------------	1	2	3	4	5
17. Little use should be made of computers in education. ---------------------------	1	2	3	4	5
18. Computers will eventually replace -------- teachers.	1	2	3	4	5
19. Computers dehumanize education. ---------	1	2	3	4	5
20. Learning about computers is important----	1	2	3	4	5
21. If I used a computer in the classroom, it would probably free me from boring, time consuming, and tedious chores. ------	1	2	3	4	5

PART III

Directions: The following questions relate to your current knowledge of computers. Choose the best answer. Please answer all items by checking your choice.

---

1. A computer system is best described as:

__ 1. Processing
__ 2. Programming, input and output
__ 3. Input and output
__ 4. Input, processing, and output
__ 5. I don't know.

2. Computers can not be used to assist in teaching English grammar.

__ 1. True
__ 2. False
__ 3. I don't know.

3. The main duty of a computer programmer is to:

__ 1. Operate a computer
__ 2. Prepare instructions for a computer
__ 3. Schedule jobs for a computer
__ 4. Design computers
__ 5. I don't know.

4. Computer data Processing is best described as:

__ 1. The collection of data
__ 2. Providing reports
__ 3. Manipulating data according to instructions
__ 4. Using punched cards in a keypunch machine
__ 5. I don't know.

5. The physical parts of a computer are refered to as:

__ 1. Programs
__ 2. Hardware
__ 3. Software
__ 4. Manuals
__ 5. I don't know.

6. Choose the correct output for the computer program shown below:

```
10 LET A = 3
20 LET B = 4
30 LET C = A
40 LET B = C
50 LET A = B
60 PRINT A,B
70 END
```

Output

__ 1. 3,4
__ 2. 4,3
__ 3. 3,3
__ 4. 4,4
__ 5. I don't know.

7. In order to use a computer, a person must know how to program.

__ 1. True
__ 2. False
__ 3. I don't know.

8. The computer related job closest to that of a typist is:

__ 1. Computer operator
__ 2. Systems analyst
__ 3. Data entry operator
__ 4. Computer programmer
__ 5. I don't know.

9. Computers can not run without:

__ 1. Blinking lights
__ 2. Internally stored programs
__ 3. Keyboards
__ 4. All of the above
__ 5. I don't know.

10. When in operation, a computer:

__ 1. Follows a set of instructions written by people
__ 2. Recalls answers from memory
__ 3. Translates data from digital to analog code
__ 4. I don't know.

11. A basic use of computers in libraries involves:

__ 1. Information storage and retrieval
__ 2. Simulation and modeling
__ 3. Process control
__ 4. Computation
__ 5. I don't know.

12. Which of the following persons is the most likely to be associated with the design of computers ?

__ 1. Data entry operator
__ 2. Computer programmer
__ 3. Computer operator
__ 4. Computer scientist or computer engineer
__ 5. I don't know.

13. In order to program a computer, a person:

__ 1. can use any English language words.
__ 2. Can use any English or foreign language words.
__ 3. Must use programming language numbers, not words
__ 4. Must use the "words" from a programming language.
__ 5. I don't know.

14. Computer software is a term describing:

__ 1. Computer programs
__ 2. Electronic components encased in soft plastic or or rubber
__ 3. People who work with computers
__ 4. Mechanical and electronic parts of a computer system
__ 5. I don't know.

15. When run on a computer, the following program will:

```
10 INPUT A,B,C,D,E
20 LET S = A + B + C + D + E
30 LET M = S/5
40 PRINT S,M
```

__ 1. Calculate the sum of five input values
__ 2. Calculate the average of five input values.
__ 3. Print the sum and average of five values
__ 4. All of the above
__ 5. I don't know.

16. Which of the following should be considered a limiting consideration before purchasing a computer ?

__ 1. Cost
__ 2. Software availability
__ 3. Storage capacity
__ 4. All of the above
__ 5. I don't know.

17. Identification numbers and passwords are a primary means for restricting undesired access to computer files.

__ 1. True
__ 2. False
__ 3. I don't know.

18. Computer processing of data may involve:

__ 1. Searching data
__ 2. Summarizing data
__ 3. Deleting data
__ 4. All of the above
__ 5. I don't know.

19. A computer program is a:

__ 1. Course on computers
__ 2. Set of instructions to control the computer
__ 3. Computer generated presentation
__ 4. Piece of computer hardware
__ 5. I don't know.

20. Computers help people make decisions by providing correct answers to any questions.

__ 1. True
__ 2. False
__ 3. I don't know.

21. Use of computers in education always results in less personal treatment of students.

__ 1. True
__ 2. False
__ 3. I don't know.

22. A general rule or process used to solve a problem is called an algorithm.

__ 1. True
__ 2. False
__ 3. I don't know.

23. In order to use a computer you would have to be in the same building as the computer.

__ 1. True
__ 2. False
__ 3. I don't know.

24. If the statements

```
10  Print "This is a survey questionnaire"
```

and

```
100 PRINT "THIS IS A SURVEY QUESTIONNAIRE"
```

are executed, they

__ 1. Will produce the identical output.
__ 2. Will produce output that are different.
__ 3. Will cause the system to print Syntax Error.
__ 4. Will produce the two outputs on a single line of the page.
__ 5. I don't know.

25. The repetition of a group of sequential instructions is called a loop.

__ 1. True
__ 2. False
__ 3. I don't know.

PART IV

Directions: There are many topics that can be included in teaching or learning about or with computers. Please rate the importance of each of the following items by circling the number that best agrees with you.

1 = Not important
2 = Somewhat important
3 = Important
4 = Very important

---

1. Learn what happens inside a computer when it operates. ------------------------- 1 2 3 4

2. Know the major parts and functions of the hardware. ---------------------------------- 1 2 3 4

3. Learn criteria for selecting hardware. ----- 1 2 3 4

4. Identify several ways that computers receive information.------------------------- 1 2 3 4

5. Understand how a computer processes information.------------------------------- 1 2 3 4

6. Understand the difference between computer hardware and software. -------------------- 1 2 3 4

7. Learn the history of computers. ------------ 1 2 3 4

8. Learn how the human brain and a computer are alike and are different. ---------------- 1 2 3 4

9. Learn to operate a computer. ----- ---------- 1 2 3 4

10. Explain what a computer algorithm is.-------- 1 2 3 4

11. Understand the steps of computer programs.--- 1 2 3 4

12. Explain what computer programs do.----------- 1 2 3 4

13. Make modifications in programs. ------------- 1 2 3 4

14. Find errors in programs. -------------------- 1 2 3 4

15. Write programs to solve simple problems.----- 1 2 3 4

16. Know how computers store information. ----- 1 2 3 4

17. Know how to organize information so a computer could use it.---------------------- 1 2 3 4

18. Understand why computers need programs.----- 1 2 3 4

19. Use computer programs prepared by others.--- 1 2 3 4

20. Determine the usefulness of given computer programs. ----------------------------------- 1 2 3 4

21. Evaluate the quality of given computer programs. ---------------------------------- 1 2 3 4

22. Know the major uses of computers in education. ------------------------------ 1 2 3 4

23. Learn about different programming languages useful for school curriculum such as BASIC, PASCAL, LOGO, PILOT and so on. ------------- 1 2 3 4

24. Learn about factors that limit educational uses of computers. ------------------------- 1 2 3 4

25. Examine new applications of computers in education. ------------------------------- 1 2 3 4

26. Examine the impact of computers on society outside the educational setting.------------ 1 2 3 4

27. Examine how computers may personalize or depersonalize education. ------------------ 1 2 3 4

28. Consider whether the use of computers (to assist in student learning) causes the teachers to lose control of the teaching process.------- 1 2 3 4

29. Learn how computers can assist in decision making through data query systems or artificial intelligence-based systems.------------------ 1 2 3 4

30. Recognize that alleged computer mistakes are usually human mistakes. ------------------- 1 2 3 4

--------------------- The End ----------------------------

Thank You for Your Time!

APPENDIX B

LETTER TO DISTRICT SUPERINTENDENTS AND RETURN POSTCARD

The University of Iowa

Iowa City, Iowa 52242

College of Education
Division of Educational Administration
210 Lindquist Center

(319) 353-5766

1847

Dear Superintendent:

I am a graduate student at The University of Iowa attempting to determine skills in computer literacy and attitudes of teachers toward computers. I also want to specify which topics and skills identified in the literature as components of teacher computer literacy teachers believe they need to know.

My study will deal with AEA 10 secondary schools (grade 9 to 12) in Iowa.

The purpose of this letter is to obtain your school district's participation in this study by completing and returning enclosed post card. I would like to administer the mail questionnaire to a sample of teachers in your school district. I would be willing to share the responses of the teachers in your school district.

Thank you for your cooperation and assistance. I believe that this study will be useful for your school district and the University by providing relevant information for curricular planning. This study will also assist in my effort to fulfill requirements for completing my Ph.D. at The University of Iowa.

It would help greatly if you would please respond by: ________.

Sincerely yours,

Yong K. Kim
Doctoral Candidate
Division of Educational Administration

Dr. Bradley M. Loomer
Thesis Supervisor
Division of Educational Administration

Will your school district participate in the study to determine the relationships between teachers' attitudes toward computers and computer literacy and to specify the topics for a computer literacy curriculum?

Yes ___

No ___

____

Superintendent

____

School District

APPENDIX C

LETTER TO BUILDING PRINCIPALS FOR INFORMATIONS ABOUT TEACHERS

The University of Iowa

Iowa City, Iowa 52242

College of Education
Division of Educational Administration
210 Lindquist Center

(319) 353-5766

1847

Dear Principal:

We are conducting a research project in computer applications in education. We want to know the following information at secondary school level (grades 9-12). This will be used for research purposes only and will be kept completely confidential. Please fill in the following blanks.

(1) How many mathematics teachers teach at your institution?

____

(2) How many science teachers?

____

(3) How many language arts/English teachers?

____

(4) How many social studies/social science teachers?

____

(5) How many business teachers?

____

We would like you to also send this information with a list of the names of your current teachers using the stamped envelope provided.

Thank you for your cooperation and assistance. It would help greatly if you would send the information requested by: ____________.

Sincerely yours,

Y.K. Kim
Doctoral Candidate
Division of Educational Administration

Dr. Bradley M. Loomer
Thesis Supervisor
Division of Educational Administration

APPENDIX D

LETTER TO BUILDING PRINCIPALS AND INSTRUCTIONS FOR SURVEY INSTRUMENT

The University of Iowa

Iowa City, Iowa 52242

College of Education
Division of Educational Administration
210 Lindquist Center

(319) 353-5766

1847

Dear Principal:

We are presently conducting a research study to determine the current computer literacy of teachers, attitudes of teachers toward computers and applications of computers in education through The University of Iowa.

Your school district has given its consent to participate in the study at the secondary school level (9-12) in AEA 10 of Iowa.

Data provided by this survey will help answer many of the questions that are being asked concerning topics and skills teachers need to know in computer literacy, and curricular planning for teachers' computer literacy in educational settings. Your assistance in getting the required data for this study is invaluable. The results will be made available to your school district and The University of Iowa by providing relevant information for curricular planning of computer literacy for both teachers and students.

The purpose of this letter is to ask for your assistance in distributing to the selected teachers to complete and return survey questionnaires. When the teachers finish them, please collect them and send them back to me using the provided stamped envelope.

Thank your for your cooperation and assistance. It would help greatly if you would return the surveys by: ________________.

Sincerely yours,

Y.K. Kim
Doctoral Candidate
Division of Educational Administration

Dr. Bradley M. Loomer
Thesis Supervisor
Division of Educational Administration

The University of Iowa

Iowa City, Iowa 52242

College of Education
Division of Educational Administration
210 Lindquist Center

(319) 353-5766

1847

For Principals:

PLEASE READ ! ! ! !

1. We would like you to secure ten (10) teachers in the following areas:

   (1) Two (2) mathematics teachers
   (2) Two (2) language arts/English teachers
   (3) Two (2) science teachers
   (4) Two (2) social studies/social science teachers
   (5) Two (2) business teachers

2. The enclosed ten (10) surveys should be distributed to the ten (10) teachers you chose.

3. If you have only one teacher in a given subject area, please use that one. If you don't have any teacher in one of the five subject areas, that area should be left out.

4. Please collect all copies and return them by November 26, 1985 using the provided stamped envelope.

5. Please put your return address on the enclosed envelope.

Sincerely yours,

Y.K. Kim
Doctoral Candidate
Division of Educational Administration

Dr. Bradley M. Loomer
Thesis Supervisor
Division of Educational Administration

APPENDIX E

COVER LETTER FOR QUESTIONNAIRE

The University of Iowa

Iowa City, Iowa 52242

College of Education
Division of Educational Administration
210 Lindquist Center

(319) 353-5766

1847

Dear Fellow Teacher:

Teachers around the country are increasingly recognizing that computer technology is playing an important role in today's schools. We are being surrounded with information about computer literacy, computer inservice training and applications of computers in education to improve today's curricular planning for teachers' computer literacy. This survey was developed for this area to determine teachers' computer literacy, and what topics and skills they need in educational settings.

Your response to the survey will provide very important information for a doctoral study. You were randomly selected to participate in this survey. Your responses will be kept confidential. In the final report no person or school district will be identified. The results will be made available to your school district.

It will only take a few moments of your time to complete this questionnaire. When you are finished, return the survey to the person that gave it to you. Thank you for your time.

Sincerely,

Y. K. Kim
Doctoral Candidate
Division of Educational Administration

Dr. Bradley M. Loomer
Thesis Supervisor
Division of Educational Administration

APPENDIX F

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