COMPUTER LITERACY FOR EDUCATORS

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Recognizing the fact the microcomputers are becoming prevalent in the school system, this study seeks to present the information necessary for teachers to become computer literate. The following topics are included: Origin of the Computer, General Computer Information, Computer Assisted Instruction, and Effectiveness of Computer Assisted Instruction.

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TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER I

INTRODUCTION

As the computer becomes an ever increasing part of our society, and its role becomes more and more fixed in our schools, it becomes of paramount importance that teachers be computer literate. A curriculum in computer literacy must become a part of the educational experience for educators. The goal of this paper is to present, in part, the information necessary for teachers to become computer literate. This includes the following topics: Origin of the Computer, General Computer Information, Computer Assisted Instruction, and Effectiveness of Computer Assisted Instruction.

CHAPTER II

ORIGIN OF THE COMPUTER

Early Computing Devices

It is almost impossible to define the origin of the computer. The roots of the computer reach back to the dawn of man when, in ca. 30,000 BC, patterned bones were used for counting. The early Egyptians used sand calculators with pebbles for counting devices. Fowles (1980) reports that Stonehenge, built approximately 2,500 BC, appears to have been built by Bronze Age builders to predict astronomical phenomena, such as solar eclipses. In 2,000 BC, place values were invented and used by the Sumarians, and the Chinese carried the idea further by inventing the abacus in ca. 600 BC. The Chinese still use the abacus in business transactions today (Corliss, 1973).

It is possible to follow a complex chain of events that occurred throughout Europe and Asia that led inventors to the most primitive counting machines. We turn our attention to the fall of the Roman Empire (Boak, 1974). After the barbarian invasions subsided, small bands of people formed peaceful units that tried merely to exist. Among these groups were a colony of monks who used management techniques and modern technology to produce wine. Their methods of crushing the grapes with a pounding device, driven by water, led to the development of both saw mills and the cam.

These developments had implications elsewhere, such as the development of a more efficient loom and spinning wheel. Encouraged by the large amounts of money to be made in textiles, large markets and trade routes were formed throughout Europe. Cities and villages prospered until the Black Death was carried from the East to Europe, killing over one-half of the population. Despite the horror of the Plague, there was an interesting side effect. Linen was abundant, making cheap paper available, but very few men were able to write. This led to Gutenberg's invention of the printing press and the spread of knowledge in all subject areas throughout Europe (Einstein, 1978). The "knowledge boom" that resulted from Gutenberg's press encouraged the spread of inventions and mechanical devices. Monetary incentive was again the force behind the development of punched cards as a control mechanism for the Jacquard Loom. These cards controlled the weaving of complex patterns in silk fabrics.

Inventions that Became the Foundation of the Computer

In 1623, William Shickard theoretically invented the first mechanical calculator that added, multiplied and performed square roots. Unfortunately, during the planning stage, the invention was destroyed in a fire. In 1624, Corliss (1973) reports Blaise Pascal invented an adding machine. It was a digital, decimal machine operated by gears inside the machine.

In 1820, Charles Babbage began designing a machine he called the "Difference Engine". Babbage completed his machine in 1822. It was designed to calculate polynomials. The mechanism was run by a collection of gears and levers, accurate to six places (Morrison, 1961).

Bernstein (1964) reports that Babbage was not satisfied with his limited Difference Engine. With the support of the British Government, Babbage set out to design a machine that was accurate to twenty places. He called this the "Analytical Engine". Unfortunately, building the machine's precision gears and delicate mechanism was beyond the scope of the early machinists. Many of Babbage's ideas became the foundation of modern computers.

Halacy (1970) describes the Analytical Engine as Babbage's "dream" that had great calculating flexibility. Its vast assemblage of cogs, levers and gears would be driven by steam, as electricity was not available. The "store" or memory consisted of wheels engraved with ten digits. One thousand fifty-digit numbers would be found in the "mill" where computations took place. Just as modern computers, the answers would be printed automatically. Another similarity of significant importance is the fact that the machine was controlled by punched cards. These control cards, Halacy (1970) points out, were used in Herman

Hollerith's counting device to conduct the United States Census of 1890.

The need for mechanization of information became obvious as the Census of 1880 was compiled. There were 50,000,000 people in the United States at the time of the Census of 1880 (Corliss, 1973). The information collected during this census took seven and one half years to compile, making it obsolete.

Hollerith had worked with this census and was aware of the problems. Charles T. Meadow (1970) reports Hollerith was able to take the control cards of the Jacquard Loom and use them to tabulate data. The device worked by lowering an electric contact on a punched card sending signals where contact was made with a layer of mercury beneath the card. A hole was punched in the appropriate place on the card, and as electric contact was made, a meter registered the information.

Hollerith's machine tabulated the information from the Census of 1890 in just two years (Meadows, 1970). The population had been determined in merely six weeks. Hollerith went on to start a tabulating company in 1896, which was later reorganized and in 1924 was named International Business Machines.

First Modern Computers

Alan Turing, at Princeton University, in 1936, theorized a machine capable of solving mathematical problems according to algorithms. These thoughts became part of the model for modern computers. In 1944, Mark-I was built. This was the first large scale automatic digital computer. It was built with the cooperation of Harvard University and International Business Machines. It was then the fastest computing machine invented (Bernstein, 1964). Shortly after that, another computer, ENIAC (Electronic Numerical Integrator and Computer), was designed and built at the University of Pennsylvania. Its purpose was military and was used in decoding German messages during World War II. Bernstein (1964) states the importance of ENIAC was that it utilized a much faster electrical switch, the vacuum tube. This could be turned on and off in about a millionth of a second, literally thousands of times faster than the relay switches of Mark-I.

After World War II much study and development went into these electronic computers. Corliss (1973) reports both business and universities actively participated in the research. The original computers were large, containing thousands of vacuum tubes, resistors, capacitors and switches which were programmed by special boards wired from outside the computer.

Anyone who is old enough to remember the wide use of vacuum tubes in household appliances can easily imagine the maintenance problems involved with these early computers. These problems included heat generation, replacement of tubes, and space utilization. Fortunately, in 1948, Bardeen and Brattain invented the first transistors which replaced the vacuum tube and greatly reduced the maintenance problems of computers.

An important development occurred in 1971 when Itel Corporation developed the microprocessor chip. This small chip, made of silicon, has been responsible for reducing costs, size, and maintenance problems as well as increasing efficiency of computers. It literally has revolutionized the electronic industry.

CHAPTER III

GENERAL COMPUTER INFORMATION

There are two major classes of computers: digital and analog. The digital computers are the calculating computers, those that sort and store date placed into systems, compile it, and present information to the user. Analog computers are simulators. They measure rather than count.

There are three types of digital computers in use today: main frame, minicomputer, and microcomputer. As their names suggest, we distinguish between these computers by their relative size. However, there are other important differences among them.

Of the three computer types, main frames have the largest memory capacity and data base. They process information very quickly and efficiently. These computers tend to be generally large, very expensive devices that are used in large companies, universities and government. They are capable of handling many different computer languages and have many optional equipment devices associated with them. Main frames demand much space and are complicated to operate. Skilled technicians must be available during operation. Main frames require large amounts of energy to operate and have high speed capability. Several users may interact with the computer simultaneously. Maintenance and repair can be very costly.

When compared to microcomputers, minicomputers have greater memory capacity. As the technical advances of the silicon chip continue, the gap between minicomputers and microcomputers will close. Minicomputers are the middle sized computers. When compared to main frames, minicomputers take up much less space, are generally slower, require less energy, need fewer operators and cost less to operate and repair. Cost of the minicomputer is much less than the main frame and can be several thousand dollars greater than the microcomputer.

The memory capacity of a microcomputer depends on the amount of money the consumer is willing to spend. Some microcomputers have expandable memory, increasing the capacity beyond that of some minicomputers. Microcomputers, or personal computers, have been designed for the small business, individual, or school. They usually accomodate one user at a time. They are small in space requirement and range in price from under $100 to several thousand dollars.

There are several devices used to communicate with computers. The most common are the terminal, a television screen with a keyboard, and key punched cards that are read into the computer by a device known as a card reader.

It is interesting to note that communication between microcomputers, minicomputers and large computers is possible. This connection is called "interface" and is accomplished by an electronic link between computers. Telephone lines are used to transmit data by long distance from one computer to another. A special device called a modem connects computers to the telephone lines and makes the electrical impulses understandable to the separate computers.

Anatomy of a Microcomputer

Every microcomputer has certain key parts; these are the Central Processing Unit (CPU), memory, mass storage and and input/output devices.

The Central Processing Unit or "chip" is sometimes called the "brains" of the computer because it controls and coordinates the computer system and actually does the tasks directed by the programmer. The CPU is approximately the size of a dime and is composed of thousands of circuits or electrical "on/off" switches. These switches are triggered by the information being processed. The configuration of the switches resulting from the processing tells the computer how to respond and what tasks to perform.

Memory is the part responsible for storing programs and data needed to run the computer and execute tasks requested by the programmer. It is also composed of "chips". When we speak of size of memory, we refer to "bits" and "bytes". A bit is the smallest measure of information in a computer, stored in a circuit switch as a "1" for "on" or a "0" for "off". This system of "1" and "0" is the basis of machine code or Binary Language, discussed below. Bits are arranged in groups called bytes. Early microcomputers had eight bits per byte. All bytes are so small we refer to groups of them or "kilobytes" or simply "K", meaning one thousand bytes. 64K means 64 Kilobytes or 64,000 bytes or 512,000 bits of memory capacity. Each byte contains one number or one alphanumeric character. The amount of memory available to a user is extremely important and should be considered carefully when selecting a system.

Memory is divided into two major areas, "ROM" (Read-Only Memory) and "RAM" (Random-Access Memory). ROM is the permanent set of instructions that are an integral part of the computer. ROM tells the computer how to carry out instructions. In most systems, ROM is not accessible by the user. RAM is used to store the information supplied by the programmer. It is not permanent and is erased when the system is turned off, goes down or loses electricity.

In the microcomputer, both CPU and memory, discussed above rely on the silicon chip. Silicon is an element with a unique property called semiconduction. Because silicon is a semiconductor and forms very pure crystals, it allows scientists to develop complex circuits without the use of wires. We call these integrated circuits. Thousands of these circuits may be placed on a 3/8 inch silicon chip. The silicon chip has revolutionized the computer. The space requirement for modern computers is much less, costs have been reduced and the speed of the computer has been increased.

Two common methods used to store data are magnetic tape and magnetic disk. Magnetic or cassette tape is placed into a cassette player interfaced with the microcomputer. Data is stored on the tape in the form of sound. When a user wants a program stored on tape, the computer reads the tape sequentially. For example, to find a program named TRIG the computer reads from the beginning of the tape until it finds TRIG. Magnetic or floppy disks work basically the same way. However, instead of using a cassette player the disk is placed into a special device called a disk drive. To locate TRIG, the computer searches its disk location in a directory and then goes directly to the program. Disks store more information than cassettes, operate more efficiently, and are more expensive.

In order to communicate with computers and have them communicate with the programmer there must be some form of input and output device. These devices commonly include the television monitor, keyboards and printers. Peripherals are extra devices or components used with the basic computer system. These devices include printers, disk drives, cassette recorders, speech synthesizers and modems.

Communicating with Computers

Binary Language, or machine language is the means by which a computer communicates with the programmer. It is possible to give the machine instructions in machine language, but this is complex and used primarily by computer engineers, computer scientists, and people interested in advanced programming.

The term algorithm is constantly used with reference to computers. An algorithm is the process of analyzing a problem and using a step-by-step, logical solution to solving the problem. An example of a common algorithm is the system employed by long hand division.

Flowcharts are a very important tool used with algorithms. Flowcharts are helpful in designing programs because they have symbols that help a programmer break the algorithm into steps. The basic flowcharting symbols include; start/end, process, decision, connector, and arrow. (See Figure 1.) Examples of program design using flowcharts are found in Figures 2 and 3.

Another tool that is used to organize the planning stage of programming is called an Input/Output Diagram. It involves the use of chart containing three columns; Input, Process, and Output. (See Figure 4.) Placed in the "Input Column" are the ingredients or data necessary to solve the problem. The "Process Column" tells how the program will change the input to obtain the results, written in the "Output Column". (See Figure 5.)

Unfortunately, many people do not use flowcharts or Input/Output Diagrams to help them when designing programs, nor do they use any other means of organization prior to writing a program. This poor programming technique can lead

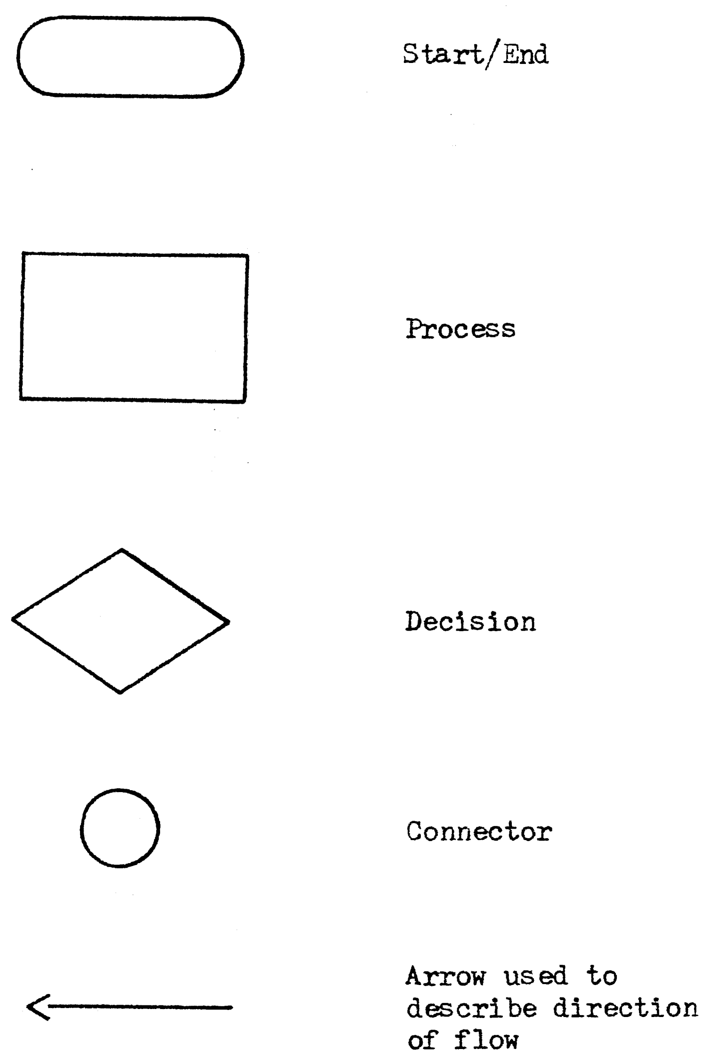

Figure 1. Flowchart Symbols

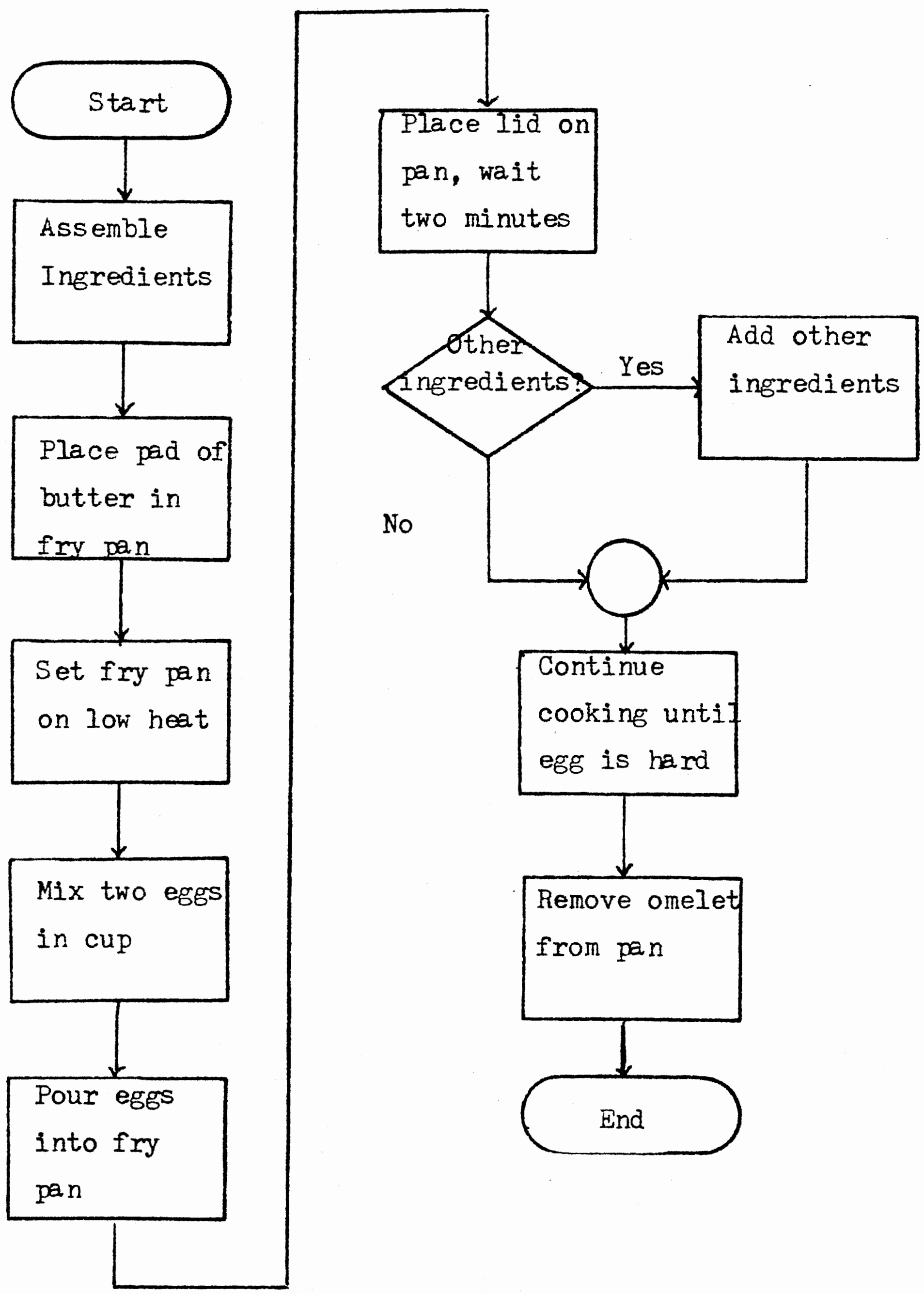

Figure 2. Flowchart of the Algorithm That Solves the Problem, "How do You Make an Omelet?"

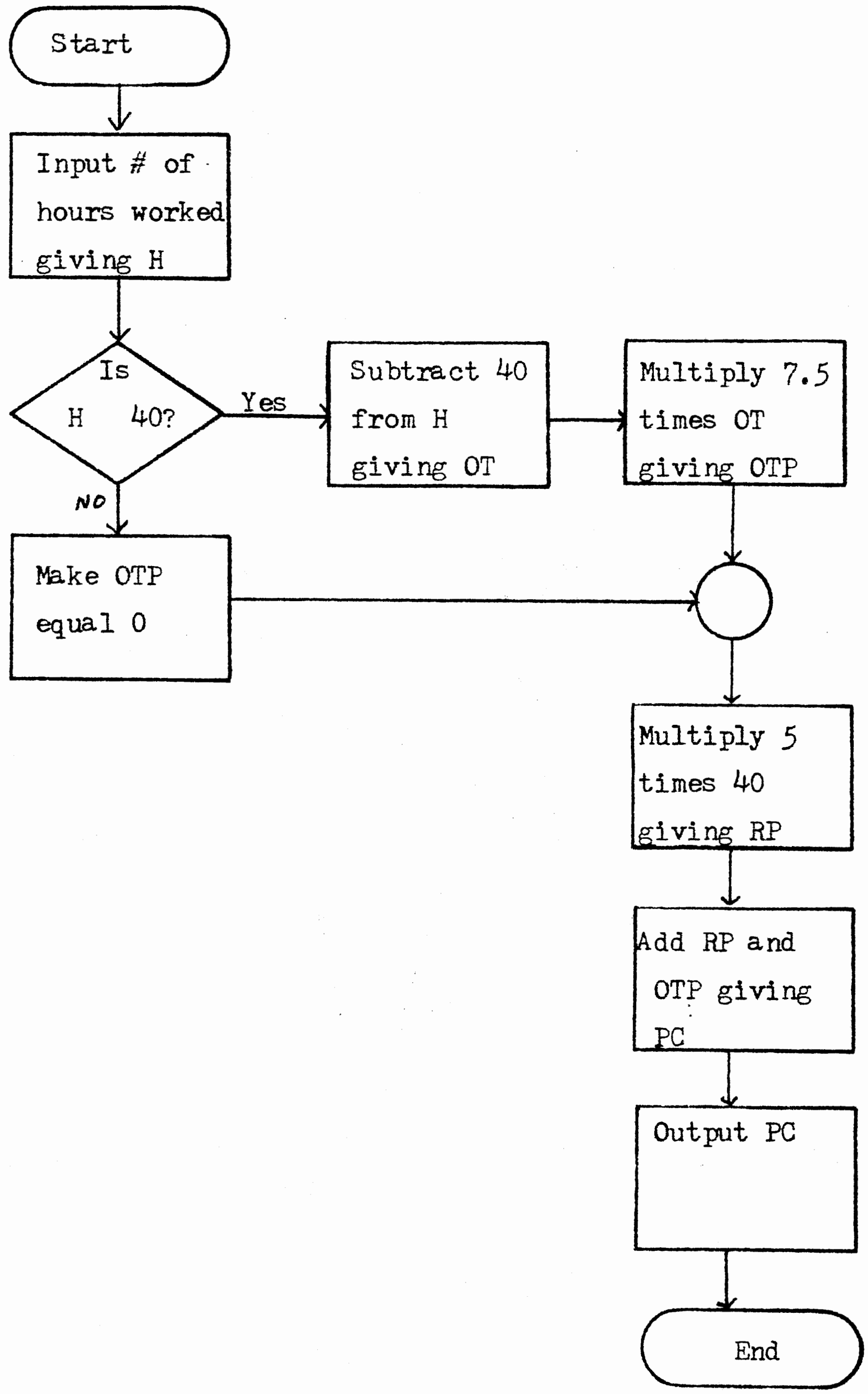

Figure 3. Flowchart of the Algorithm That Solves the Problem, "What is the Paycheck of an Employee Earning $5.00/hour?"

INPUT	PROCESS	OUTPUT

Figure 4. Input/Output Diagram

INPUT	PROCESS	OUTPUT
1. Obtain fry pan	Place pad butter in pan Heat on low	Melt butter
2. Two eggs	Mix eggs Pour eggs into pan Heat	Solid egg forms
3. Other ingredients	Add to eggs Complete heating	Remove Omelet

Figure 5. Input/Output Diagram of the Algorithm That Solves the Problem, "How do You Make an Omelet?"

to algorithms that do not solve problems. Advanced planning is important and recommended.

Software Evaluation

Most teachers do not have the time or expertise needed to write complex software. Therefore, these persons will be faced with the question, "How do I determine what software is best?" Educational catalogs are available from commercial houses. Clearing houses are becoming popular. Their purpose is to identify quality materials. Examples are Conduit, for college level software; and microSIFT at the K-12 level. Several computer journals regularly evaluate software. Examples are Creative Computing, Recreational Computing, and The Computing Teacher. Subject area journals also evaluate software; these include The MathematicsTeacher and The Journal of Computers in Science Teaching. There are also user groups that evaluate software. These include the Minnesota Educational Computer Consortium (MECC), The Michigan Association for Computer Users in Learning which produces the MACUL Journal, and the Wisconsin Mathematics Council. Many local computer users' groups are forming, and it is the responsibility of the individual teacher to seek out these groups.

When considering the purchase of commercial software, it is imperative that teachers employ a systematic evaluation process. Commercial vendors seldom loan software to schools or individuals on a trial basis due to the fact that diskettes and cassettes can easily be copied. Consequently, initial information must be obtained through requests and research. The information should include instructional objectives, grade levels or ability levels of intended audience, instructional materials available to support the program, and testing or validating of results of the software. Certain technical information should also be obtained including equipment needed to run the software, and the language in which the program is written.

The National Council of Teachers of Mathematics (NCTM) Guidelines (1981) recommend the following additional areas be evaluated: size of the intended audience, length of the program, type of instructional method, freedom from instructors' assistance, quality and clarity of directions, content's validity and compatibility with other materials, motivational and instructional style, and social characteristics.

CHAPTER IV

COMPUTER ASSISTED INSTRUCTION

History of Computing in Schools

Microcomputers' use in education can be divided into two broad categories; Computer Managed Instruction (CMI) and Computer Assisted Instruction (CAI). CMI is a method of managing educational and administrative tasks. Also involved is the diagnosis of student learning and evaluation. CAI is a method of instruction in which the computer is used to instruct students. The computer has several modes of teaching such as Drill and Practice, Tutorial, Simulation, and Problem-Solving.

The first programs to use computers for instructional purposes were begun in the 1960s. These projects utilized main frame computers. In 1960, The University of Illinois was the location of the first major program for Computer Assisted Instruction. This teaching system called PLATO, Programmed Logic for Automatic Teaching Operation, was invented and designed by Dr. Donald Bitzer. Bitzer originally designed PLATO to be supplementary to course work, but it soon spread horizontally to complete course work in several subject areas.

In 1972 several elementary schools in the Champaign-Urbana area were equipped with terminals for a pilot computer-based mathematics education program. According to a study by Kolstad and Lidtke (1981), this pilot program helped students increase motor skills and taught the children to manipulate prepackaged programs. They found the program to be so motivating that some students would spend twenty hours per week on the terminals.

In 1975 a more structured system for learning programming was introduced to junior high students by the PLATO program. The Kolstad and Lidtke (1981) study demonstrates the popularity of this ongoing program. Today there are at least one hundred precollege students using the PLATO system to learn programming. The system includes an occasional short course, but most instruction is individualized and is learned through peer group interaction. Students are allowed to use the PLATO system as long as they are making progress in learning programming or learning motor skills development.

Stanford University pioneered computers in the elementary schools in the mid 1960s. The children, ages kindergarten through fourth grade, were exposed daily to mathematics lessons by the Stanford computer. In later years, both the age group and the subject area had expanded.

Instructional Uses of Microcomputers

Several different schemes are used to explain the instructional use of computers. One scheme, proposed by

Chambers and Sprecher (1980) provides two models: adjunct-primary and simplistic-complex. In the adjunct-primary model, adjunct refers to supplemental material used with traditional classroom learning, and primary refers to the situation where the computer supplies the majority of instruction. In the simplistic-complex model, simplistic refers to programs written using minimal hardware, and complex refers to utilizing graphic capabilities and more complex programming languages.

Another scheme by Forman (1982) divides CAI into Drill and Practice, Tutorial, and Simulations. Perhaps the most classic and universal application of microcomputers in the classrooom is drill and practice. Drill and practice is the process of assisting the student in maintaining and mastering a skill. A computer can patiently drill a student through a problem area providing a courteous and relevant supply of problems and, most importantly, feedback to the student. The student may work independently on a huge array of subject material. Subjects for drill and practice including spelling, addition, multiplication, names of capitals, presidents, grammar rules, parts of speech, Periodic Chart Symbols, anatomy, literally anything that is memorized can be drilled efficiently by the computer.

Tutoring is a process of assisting the student in acquiring a skill. Tutorial work for the computer is a logical step from drill and practice. Not only does tutoring carry the drill and practice a step further, but it is useful in more complex learning situations. For example, the computer can assist students in increasing comprehension skills by providing a reading exercise, asking questions and then reviewing the text when necessary.

Microcomputer simulation is any computer model of a scientific or social event or phenomenon. Microcomputer simulations or models may be used with several different subject areas. One area often using simulations is Social Studies. An example is a simulation of the variables that cause urbanization changes. Simulations have also proved effective in scientific areas such as chemistry. A simulation of a titration or other experiments that would involve the use of dangerous chemicals or long, slow processes may be efficiently and effectively simulated by microcomputers.

Braun (1975) has worked in association with the National Science Foundation on the Huntington Projects (studies involving computer simulation). The following are his guidelines for determining appropriate use of simulations: (1) when they are used to improve the student's understanding of subjects treated inadequately in conventional laboratories, (2) to provide opportunities for learning by observation other than by reading or by being lectured to, and (3) to permit presentation of concepts not now possible because of limited student preparation in mathematics.

An area receiving much computer assistance in recent years has been mathematical problem-solving. Computers can be used as "number crunchers" and can also be involved in very complex calculations, performing them rapidly and correctly. The development of problem-solving skills is very important. Using the computer to help solve mathematical problems causes students to work through a problem by doing a thorough analysis and choosing a sequence of steps to arrive at the solution. This algorithmic approach may be applied to problems outside school.

Gaming is a method of instruction that involves competition. It can provide student motivation and interest to work with the computer. It is a valid teaching tool in many subject areas. There are many categories of games. Ahl (1973) divides games into the following categories: guessing games, classification, matrix, history/government, logic, gambling, card and board, sports, space, war, words, and dates. The instructional validity of gaming is limited only by the creativity of the teacher/programmer.

Bork (1980) provides a third scheme used to explain instructional uses of computers. Bork uses a dialogue format, or an interactive conversation between teacher and student as mediated by the computer. The computer is able to respond to the student's work with an appropriate response. The emphasis here is placed on the discovery approach, and the computer dialogues are effective in accomplishing that end.

Taylor (1980) proposes a fourth scheme with three modes: Tool, Tutor, and Tutee. The tool mode provides information to the user which might otherwise be unobtainable. The system may be used to store information such as library files, inventory, grades and other essential records. Word processors are a part of this mode. Tutee is another name for problem-solving. In this mode, the student is in control and does the creative task of programming. As Papert (1980) advocates, computers used in the tutee mode help develop problem-solving strategies and thinking skills.

Papert has been working since the early 1970s to integrate tutee mode microcomputers into all levels of education, especially early elementary and preschool. He has designed a computer programming language called LOGO which is used with microcomputers. His basic premise agrees with Piaget's tenant that children learn best and remember more when they become actively involved in the learning process.

As Papert explains in his book Mindstorms (1980), the student has control of the learning situation by programming the computer. It is this programming that teaches a child how he thinks. Papert goes further into Piagian Theory when he speaks of the building of intellectual structures. He contends that children, working with computers, are active builders of their own intellectual structures and are able, with the help of computers, to make the transition from "concrete" to "formal" thinking. The computer helps make these formal operations more concrete by helping the students isolate "bugs" or mistakes in their programming.

LOGO uses "turtles" and "sprites". Learning takes place as the students manipulate the movements and colors of the objects on the screen. This programming by the students allows them to have some kind of success because there is no such thing as an error, only a "bug to overcome.

Papert's work provides us with important evidence that children are capable of dealing with complex problems at a much earlier point than that at which they are traditionally introduced. Problem-solving skills are traditionally introduced so late children lose interest.

Special Students

Handicapped and Special Education

Computers are a useful general-purpose tool in the special education curriculum. In this area it is very important to provide small systematic units of material, repetition, immediate feedback and individualized instruction.

As a prosthetic device, the computer can work with deaf, blind, and physically impaired students. Although many of these devices are still in the experimental stage, the future appears bright. Ballenger (1979) examines a system that translates print to tactile stimulation enabling a blind operator to read material on the screen. Watson (1978) reports that deaf are actively using computers for various subjects. One particular area is mathematics. In a study of 3,000 deaf students by Suppes, Fletcher, Zanotti, Lorton, and Searle (1973), of those students involved in a CAI mathematics project, the program increased their mathematics skills during that time.

Gifted and Talented

Keating (1976) states that three components are necessary for gifted students to have creative thinking experiences: the possibility of divergent thinking, familiarity with a subject so as to be at its frontier, and the need for judgment and evaluation of performance. The computer can supply all of these. Computers may be used as supplemental material to take these students a "step beyond". They may be used for creative development, allowing the students to interact with the computers on a programming level. These students may develop programs providing supplemental materials for other classes as requested by the teaching staff thereby developing a library of software materials for the entire school. Or, gifted students may produce programs for their own use and interests.

Humanities

Jones (1981) indicates that computer systems such as PLATO and similar systems have introduced a wide range of subject areas. For instance, an area not commonly thought of in connection with computing is Arts and Humanities.

The fundamentals of music have been computerized by a number of facilities, such as the Minnesota Education Computer

Consortium, PLATO from the University of Illinois, University of Delaware, Ohio State University, University of Georgia, University of Iowa, Stanford University, and State University College at Potsdam. A report by Jones (1980) regarding the Center for Computer Research in Music and Acoustics found the computer, when used in musical composition, is more flexible than a conventional musical instrument because it can generate any sound produced by loudspeakers, transform sounds by means of microphone and digital-to-analog converts, modify musical input, and simulate the location and movement of sounds. Among the nonconventional sounds capable of being made by a computer are those of thunder, insects, birds, wind, and human-made non-speech sounds.

With the aid of a computer it is possible to provide students with laboratory experience in social studies. The computer can provide an "environment" for analyzing data, constructing and manipulating models and testing hypotheses. An example of a computer simulation for social studies is an election. The computer can simulate the campaigns of each candidate, present important issues and provide demographic information regarding the issues. It finally will predict the outcome, simulating the election process.

CHAPTER V

EFFECTIVENESS OF COMPUTER ASSISTED INSTRUCTION

Unfortunately very few studies involving microcomputer CAI exist. The majority of the research is based on main frame studies. The following studies are main frame programs.

Some of the more recent studies by Foreman (1982) and Gleason (1981) conclude that learning gained using CAI is better than, or at least equal to, that which takes place with traditional methods of teaching; and, it takes less time to meet educational objectives using CAI.

The time savings can be significant, as much as 20 to 40 percent (Gleason, 1981). Other conclusions involving students are that use of CAI resulted in improved attitude toward computer use, increased student motivation, and the development of replicable programs by students for use with other computers.

Further evidence for the effectiveness of CAI comes from the study conducted by Carmen and Kosberg (1982). In working with emotionally handicapped children, aged seven to fourteen, who were working two to four years below grade placement in mathematics and reading, CAI proved effective. Before being exposed to CAI on the PLATO system, the students were given Stanford Achievement Tests. Although no significant difference was identified between the computer group and the non-computer group on the Post Stanford Achievement Test, there was a positive change of attitude and motor skill development occurred. These changes were noted by a comparison made via an observer between attention-to-task during computer use and during regular class instruction.

Another study regarding the effectiveness of CAI was conducted by Hungate (1982). This study was concerned with readiness skills of Kindergarten age children. Hungate found the subjects performed four of six tasks more effectively than the control group and even at their young age, the students were able to operate the equipment.

In the CAI study conducted by Steinberg (1980), it was found that students learn most effectively when given direct feedback on the accuracy of each response. This is routinely performed by computers.

The Chicago City Schools Project began in 1971. Over 12,000 fourth through eighth grade students using 850 terminals are involved in this project, studying mathematics and reading. The results have been impressive. The average increase in reading ability was 5.4 months per student for each ten months of regular classroom instruction (Passman, 1979).

Kearsley, Hunter and Seidel (1983) have summarized a study of fifty major computer projects. The projects were

placed in eight categories: Development of Prototypes, Conceptual Demonstrations, Major Implementations and Evaluations, Dissemination, Authoring Languages/Systems, Intelligent CAI, Innovative Environments, and New Theory. From this study, the authors state several conclusions:
(1) computers make instruction more efficient and effective,
(2) little is known about individualized instruction,
(3) further study is needed in the following instruction variables: graphics, speech, motion, and humor, (4) much progress in organization of computer use has been attained,
(5) progress in authoring tools and techniques has been made, (6) better hardware and software has been developed,
(7) areas of computer instructional research is broad,
(8) Federal funding is important, and (9) much further research is needed.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

Computers in the most primitive form appear to have been in use since the beginning of mankind. Modern computers have their roots in several ancient inventions and as time passes computers continue to evolve. The use of computers in our society is all-encompassing. Without them our society's progress would slow or stumble.

In schools, the computer is becoming increasingly popular making it necessary for educators to become computer literate. In order to expedite computer education for teachers schools must: (1) identify needs (2) establish goals (3) develop certification requirements, and (4) implement teacher education.

All educators should be able to: (1) read and write simple programs (2) have a working knowledge of computer terminology (4) have an understanding of problems a computer can solve and cannot, and (5) discuss the history of computing.

A review of the literature reveals the following consistencies: (1) CAI either improved learning or showed no difference when compared to traditional classroom learning (2) CAI reduces learning time when compared to traditional classroom instruction, and (3) CAI improves student attitudes toward computers.

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VITA 2

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