Microcomputers in the Elementary School:

A Computer Literacy Curriculum
&
The Word Processor and Children


An Honors Thesis (ID 499)

by

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February 1988

# A Computer Literacy Curriculum
# for the Elementary School

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# Introduction

As society changes in response to rapid technological advances, educational goals for society must also change. One of the most discussed and misunderstood goals for today's schools is that of computer literacy. To some adults the words "computer literacy" evoke fear; fear of the unknown and of being less knowledgable about a subject than their children. Many of today's adults are unfamiliar with how computers work and seem to even rebel against them born out of a fear of losing their job to technology. However, society is inundated with computers in the homes, schools, and workplaces.

It is imperative that schools teach children about computers in order for them to best be able to successfully function in a society that is dependent on technology for handling information and solving complex problems. The term "computer literacy" has been deemed as the catch phrase to describe this realm of computer information. To some educators, if a child can define byte, BASIC, disk, and data, plus tell you that banks, airports, scientists, and tax collectors use computers, than the child is computer literate.

Other educators believe that one must be fluent in several programming languages such as BASIC, LOGO, or PASCAL in order to be classified as computer literate. However, the most comprehensive and widely accepted definition of computer literacy is ".. the ability to use suitably programmed computers in appropriate ways to assist in learning, handling information, and solving problems, and the ability to make informed judgements about social and ethical issues involving computer and communication systems." ( Hunter, p.9)

The following computer curriculum is based on this definition and is designed for elementary grades 1-6. Goals and objectives for both the overall curriculum and for individual grades are to be used as a tool to aid in planning and classroom instruction. There is also an appendix included to aid in implementing this curriculum.

Elementary Computer Literacy Goals and Objectives

## 1. Fundamentals
    A.  Ancient calculating devices
    B.  Programmable calculators and computers
    C.  Current computing equipment
    D.  Everyday uses of computers

Goal:  The student will become aware of the historical background and development of computers, will recognize ways in which computers affect our lives, and will examine the projected impact of computer technology on society.

## 2. Structure
    A.  Physical components of a computer
    B.  Components of a computer system
    C.  How a computer works

Goal:  The student will describe characteristics of a computer system and will know how the parts of the computer being used in the school fit into a system.

## 3. Limitations
    A.  Physical (hardware) limitations
    B.  Practical limitations
    C.  Ethical and moral issues

Goals:  The student will become aware of the limitations of computers, both the limitations imposed by the type of computer being used, and limitations shared by all computer systems.  The student will examine ethical and moral issues raised by computer use.

## 4. Control
    A.  Operating the computer
    B.  Keyboarding skills
    C.  Software self-selection
    D.  Using computer games and drills
    E.  Using data bases
    F.  word processing

Goals: The student will develop a sense of control over computers and
learn a variety of tools and techniques for exercising that control.

## 5. Problem Solving and Programming Skills
      A. Algorithms and pseudocodes
      B. Flowcharts
      C. Programming languages
      E. Problem-solving

Goals: The student will develop problem-solving and decision-making
skills through interaction with a computer.

Goal 1: The student will become aware of the historical background and development of computers, will recognize ways in which computers affect our lives, and will examine the projected impact of computer technology on society.

**Objectives:**
The student will be able to:

1.A describe early computing devices.

1.B interact with a variety of computer-like devices used for recreational, instructional, and computational purposes.

1.C describe how computers are used in the working world today and how they may be utilized in the future.

1.D give examples of how computers are used in personal daily lives.

1.E describe changes in career opportunities brought about by the advance of computer technology.

### Topic Units

Grade 1: Finding computers in your own home (e.g. calculators, Speak and Spell, Little Professor, sports games, board games)

Grade 2: Computers in daily life (money machines, Atari, grocery check-out, hospitals)

Grade 3: History and development of computers (abacus, adding machines, calculators)

Grade 4: Computers in the working world-information processing (research, government, business)

Grade 5: Computers in the future (robotics, CAD)

Grade 6: Career opportunities in computers (programmer, systems analyst, MIS)

Goal 2: The student will describe characteristics of a computer system and will know how the parts of the computer being used in the school fit into a system.

**Objectives:**
The student will be able to:

2.A name the five parts of a computer and describe their functions (i.e. input, memory, control, processing, and output units).

2.B describe the relationships of computers within a network and the role of personal computers.

2.C recognize that a computer needs instructions to operate, and understand that instructions are included in the memory as the operating system and also are provided to the computer as a program.

2.D differentiate between computers according to their function.

## Topic Units

Grade 1: The parts of a personal computer (input device, CRT, keyboard, printer, and output device)

Grade 2: The parts of a computer system (input, memory, control, processing, output)

Grade 3: Storing information (external memory)

Grade 4: Inside the computer (internal memory)

Grade 5: Input and output devices (keyboard, joysticks, printers)

Grade 6: Functions of computers (general purpose vs. dedicated)

Goal 3: The student will become aware of the limitations of computers, both the limitations imposed by the type of computer being used and limitations shared by all computer systems. The student will examine ethical and moral issues raised by computer use.

## Objectives:
The students will be able to:

3.A  recognize some of the limiting factors of computers (i.e. memory size, speed, accuracy, availability of software, lack of compatability with other computers, etc.).

3.B  distinguish between the types of problems which can be solved by computers and which cannot be solved be computers.

3.C  analyze the ethical implications of easy access to computerized information (e.g. invasion of privacy, criminal use, etc.)

3.D  be aware of the moral implications of increased computerization on society (i.e. on man's sense of identity and purpose, the depersonalizing effect, the sense of loss of control of one's life, etc.)

3.E  discuss the copyright laws and their relationship to copying software

## Topic Units

Grade 1: Human memory vs. computer memory

Grade 2: Understanding limitations of personal computers

Grade 3: Understanding limitations of industrial computers

Grade 4: Copyrighting

Grade 5: Ethics (piroting)

Grade 6: Computer crime (embezelling, record management)

Goal 4: The student will develop a sense of control over computers and will learn a variety of tools and techniques for exercising that control.

**Objectives:**
The student will be able to:

4.A turn the computer on and off, load programs from a disk,and use the standard keyboard and keys common to data entry such as enter and return.

4.B describe and use correct care on the computer components, peripheral devices, and tapes or disks.

4.C use a typing drill and practice program to become acquainted with the keyboard and the standard hand and finger positions for using the keyboard.

4.D create, edit, and print documents utilizing a word processing program.

## Topic Units

Grade 1: Correct handling of computers (turning on and off, using disks)

Grade 2: Equipment control (power outage, control switches)
Beginning computer vocabulary

Grade 3: Beginning keyboarding

Grade 4: Keyboarding drill and practice program
Beginning word processing (entering text)

Grade 5: Word processing (editing)
Computer vocabulary

Grade 6: Advanced word processing

Goal 5: The student will develop problem-solving and decision-making
skills through interaction with the computer.

**Objectives:**
The student will be able to:

5.A  design simple algorithms and pseudocodes in order to solve a problem.

5.B  use a flowchart to organize the sequence needed to solve a problem.

5.C  design a simple program using a computer language such as BASIC or
LOGO

5.D demonstrate the steps necessary to have a computer perform a
problem-solving task (i.e. define the problem, analyze the problem and
decide on an algorithm for the solution, construct a flowchart or other
model of the algorithm, write the program, load the program into the
computer memory, test-run the program, debug the program if
necessary, and document the program)

## Topic Units

Grade 1:  concrete sequencing exercises
LOGO physical exercises

Grade 2:  concrete problem-solving tasks
beginning LOGO on terminal

Grade 3:  more LOGO commands (st,pc,setpc,ht, erps,pots,pops)
beginning debugging

Grade 4:  more LOGO
designing algorithms and pseudocodes

Grade 5:  beginning BASIC
flowcharting
procedures: writing, using, saving, retreiving, repeating

Grade 6:  BASIC programming

# Appendix

# Glossary

**ASCII**
American Standard Code for Information Interchange. Used to code all information that is not numbers or arithmetic symbols.

**Assembler**
Program that translates input that is written in assembly languages.

**Assembly Language**
Language designed to enable programmers to use code words instead of binary code. A special program, the assembler, handles the job of translating the code words into machine language.

**BASIC**
Beginner's All-purpose Symbolic Instruction Code. Computer language developed by John Kemeny and others at Dartmouth College in the 1960's. It is most popular language for use on personal computers.

**Binary System**
Code in the form of ones and zeros that lets a computer store, handle, and process information and commands. The computer uses circuits *on* and *off* (or with high or low levels of electricity ) to represent the ones and zeros. The binary number system was developed by Gottfried Leibniz.

**Bit**
Binary digit. Each bit is one circuit on or off.

**Boot**
To start a computer.

**Bug**
Mistake in a program that keeps it from working.

**Byte**
Group of eight bits.

**Central Processing Unit**
Integrated circuits that form the processing and memory units of the computer.

| | |
|---|---|
| **Character** | Any letter, number, punctuation mark, or space handled by the computer. |
| **Chip** | Tiny, thin slice of silicon with thousands of miniature circuits layered on top of it. |
| **COBOL** | Common Business Oriented Language. Designed for writing reports and handling large amounts of data. This computer language is used mainly in business. |
| **Command** | Order given to a computer. Commands are most often given through a keyboard, but they may also be given through a light pen (when drawing models or designs), a joystick, or a microphone. |
| **Compiler** | Program to translate compiled high-level languages such as COBOL and FORTRAN. Compiled programs are generally brought in only after the entire program has been typed in the high-level code. |
| **Computer** | Machine that can accept, process, and store information or a set of commands. Works best with information that can be described in mathematical terms. |
| **Cursor** | Lighted or blinking symbol that is always on a computer screen to mark the next spot where a message will be presented or a symbol will appear if any key is pressed on the keyboard. |
| **Data** | Information. |
| **Encode** | To change from plain language into code. |
| ***External* Memory** | Data or instructions stored on a disk, cassette tape, or reel of tape. External memory is not as quickly available to the computer as ROM or RAM. It is not erased when the computer is turned off. |
| **Flowchart** | Graphic outline of the steps needed to do a specific job on the computer. |

**FORTRAN**      Formual Translation. Computer language used mainly in math and science research.

**Input**        Term used to describe any information or orders given to a computer.

**K**            1,024 bits. A computer's "intelligence" is determined by the amount of it's K-the amount of storage space in its memory.

**Memory**       The part of a computer where data and instructions are stored so they can be used again. Storage may be in the form of ROM, fast memory (RAM), or external memory.

**Nanosecond**   One billionth of a second, the time the fastest computers today take to handle, sort, and process data. At this rate, computers can solve a billion problems per second.

**Microsecond**  One millionth of a second, the time the average computer takes to work.

**Operating Systems**   Master control program that directs bringing in other programs, moving data, and processing data.

**Output**       Response from the computer in usable form.

**Pascal**       Computer language named after Blaise Pascal. It is designed to solve mamy of the problems that exist in languages developed earlier and to make programming more efficient.

**Peripheral**   Any piece of hardware attached to the main body of the computer.

**Pixel**        Smallest picture element.

**Program**      Set of orders that tells a computer what to do.

**RAM**          Random-access memory, of fast memory. When the computer is turned on, information and instructions can be stored in the CPU'S circuits. Fast memory is erased when the computer is turned off.

**ROM**                 Read-only memory, or information and instructions permanently stored in the CPU's chips. It is instantly available for processing when the computer is turned on. It is not erased when the computer is turned off.

**Software**            Computer programs.

**String                Variable that stores words (see Variable). A string
Variable**              variable's code name always ends in a dollar sign ($).

**Variable**            Stored information identified with a code name. The computer handles finding a location in its circuits to store the information and searches for it each time that code name is used to request the information.

# Recommended Books for Teachers and Administrators

*Are you Computer Literate?*
Karen Billings and David Moursund
Dilithium Press, 1979

*Bits 'n Bytes About Computing: A Computer Literacy Primer*
Rachelle S. Heller and C. Dianne Martin
Computer Science Press, 1982

*Calculators, Computers and Elementary Education*
David Moursund, 1977
    The Math Learning Center
    325 13th St., NE, Unit 302
    Salem, OR 97301

*The Compleat Computer*
Dennie L. Van Tassel
SRA, 1976

*Computer Education for Elementary and Secondary Schools*
Education Board of the Association for Computing Machinery, 1981
    ACM Order Department, P.O. Box 64145
    Baltimore, MD 21264

*Computer Literacy: Issues and Directions for 1985*
Robert Seidel, Ronald Anderson, and Beverly Hunter
Academic Press, 1982

*Computer Power and Human Reason*
J. Weiaenbaum
W.H. Freeman, 1976

*The Computer in the School: Tutor, Tool, Tutee*
Robert P. Taylor, ed.
Teachers College Press
Columbia Universiy, 1981

*Computers and Privacy*
Biological Sciences Curriculum Study, 1980

*Computers and Social Controversy*
Tom Logsdon
Computer Science Press, 1980

*Computers in Society*
Conald Sanders
McGraw-Hill, 1981

*Computers in Teaching Mathematics*
John Burton, Peter Coburn, and Grank Watson
Addison-Wesley, 1982

*Designing a Computer Support System for Schools: A Hnadbook for Administrators*
Carleton K. Finch and David Dennen
Addison-Wesley, 1980

*Introduction to Computer Simulation*
Nancy Roberts, D.F. Andersen, R.M. Deal, M.S. Garet, and W.A. Shaffer
Addison-Wesley, 1982

*Microcomputer Courseware for the Classroom: Selecting, Organizing, and Using Instructional Software*
Ann Lathrop and Bobby Goodson
Addison-Wesley, 1982

*Microcomputers and the 3 R's: A Guide for Teachers*
Christine Doerr
Hayden Book Co., 1979

*Microcomputers in Education*
Lee Marvin Joiner, G. Vensel, J.D. Ross, and Burton Silverstein
Learning Publications, 1982
    P.O. Box 1326
    Holmes Beach, FL 33509

*Mindstorms: Children, Computers, and Powerful Ideas*
Seymour Papert
Basic Books, 1980

*A Practical Guide to Computers in Education*
Peter Coburn, Peter kelmn, Nancy Roberts, Thomas Snyder, Daniel Watt, and Cheryl Weiner
Addison-Wesley, 1982

*School Administrator's Introduction to Instructional Use of Computers*
David Moursund
International Council for Computers in Education, 1980

*Teacher's Guide to Computers in the Elementary School*
David Moursund
International Council for Computers in Education, 1980

# Recommended Periodicals

*ACM SIGCUE Bulletin*
Adssociation for Computing Machinery
P.O. Box 12015
Church Street Station, NY 10249

*AEDS Journal and AEDS Monitor*
Association for Educational Data Systems
1201 Sixteenth St. NW
Washington, DC 20036

*BYTE Magazine (McGraw-Hill)*
Byte Publications, Inc.
70 Main St.
Peterborough, NH 03458

*Classroom Computer News*
P.O Box 266
Cambridge, MA 02138

*Computer Education*
Mrs. P. Jackson, The Computer Education Group
North Staffordshire, Polytechine Computer Center
Blackheath Lane, Stafford, England

*The Computing Teacher*
International Council for Computers in Education
Department Computer and Information Science, University of Oregon
Eugene, OR 97403

*Courseware Quarterly*
Academic Computing Association
P.O. Box 27561
Phoenix, AZ 85061

*Creative Computing*
Elizabeth Styles, ed.
P.O. Box 789-M
Morristown, NJ 07960

*Educational Computer Magazine*
P.O. Box 535
Cupertino, CA 95015

*Electronic Learning*
Scholastic, Inc.
902 Sylvan Ave.
Englewood Cliffs, NJ 07632

*Journal of Computer-Based Instruction*
ADCIS
409 Miller Hall
Westen Washington University
Bellingham, WA 98225

*Microcomputers in Education*
QUEUE
5 Chapel Hill Dr.
Fairfield, CT 06432

*Personal Computing*
P.O. Box 1408
Riverton, NJ 08077

# Recommended Books for Children

Atari Pilot
Atari, Inc., 1982

BASIC Discoveries: A Problem-Solving Approach to Beginning Programming
Malone and Jackson
Creative Publications, 1982

Computer Literacy: A Hands-On Approach
A. Luehrmann and H. Peckham
McGraw-Hill, 1982

Computer Literacy: Problem-Solving with Computers
Carin Horn and James L. Poirot
Sterling Swift Publishing Co., 1981

Computer Power: A First Course in Using the Computer
Mike Moshell et al.
McGraw-Hill, Gregg Division, 1982

Computers are Fun
Jean Rice and Sandy O'Connor
Denison, 1981

Computers in Mathematics: A Sourcebook of Ideas
David Ahl, ed.
Creative Computing Press, 1979

Computers in Number Theory
Donald D. Spencer
Computer Science Press, 1982

Exploring the World of Computers
Donal D. Spencer
Camelot, 1982

Illustrated Computer Science Dictionary for Young People
Donald D. Spencer
Camelot, 1982

KAREL the ROBOT: A Gentle Introduction to the Art of Programming
Richard E. Pattis

Learning with LOGO
Dan Watt
BYTE/McGraw-Hill, 1982

Logo for the Apple II
Harold Abelson
BYTE/McGraw-Hill, 1982

My Friend the Computer
Jean Rice
Denison, 1981

Radio Shack BASIC Programming
Radio Shack, Inc.
One Tandy Center
Fort Worth, TX 76102

Tales of the Marvelous Machine
R. Taylor and B. Green, eds.
Creative Computing Press, 1980

Teaching BASIC Bit by Bit
B. Friedman and T. Slesnick, eds.
Math and Computer Education Project
University of California

What Can She Be?  A Computer Scientist
Career Unit
Gloria and Esther Goldreich
Lothrop, Lee & Shepard, 1979

What Computers Can do
Donald D. spencer
Camelot, 1977

# Computer Literacy Scope and Sequence

## Grade 1

| | | |
|---|---|---|
| Goal #1 | . | Finding computers in your own home |
| Goal #2 | | The parts of a personal computer |
| Goal #3 | | Human memory vs. computer memory |
| Goal #4 | | Correct handling of computers |
| Goal #5 | | Concrete sequencing exercises (LOGO) |

## Grade 2

| | |
|---|---|
| Goal #1 | Computers in daily life |
| Goal #2 | The parts of a computer system |
| Goal #3 | Understanding limitations of personal computers |
| Goal #4 | Equipment control |
| Goal #5 | Concrete problem-solving tasks and LOGO |

## Grade 3

| | |
|---|---|
| Goal #1 | History and development of computers |
| Goal #2 | Storing information |
| Goal #3 | Understanding limitations of industrial computers |
| Goal #4 | Beginning keyboarding |
| Goal #5 | Beginning LOGO and debugging |

## Grade 4

| | |
|---|---|
| Goal #1 | Computers in the working world |
| Goal #2 | Inside the computer |
| Goal #3 | Copyrighting |
| Goal #4 | Beginning word processing |
| Goal #5 | Designing algorithms and pseucodes |

## Grade 5

| | |
|---|---|
| Goal #1 | Computers in the future |
| Goal #2 | Input and output devices |
| Goal #3 | Ethics |
| Goal #4 | Word processing |
| Goal #5 | Beginning BASIC |
| | Flowcharting and procedures |

## Grade 6

| | |
|---|---|
| Goal #1 | Career opportunities in computers |
| Goal #2 | Functions of computers |
| Goal #3 | Computer crime |
| Goal #4 | Advanced word processing |
| Goal #5 | BASIC programming |

# The Word Processor
# and Children

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One of the most discussed and misunderstood goals for today's schools is that of computer literacy. To some adults the words "computer literacy" evoke fear: fear of the unknown and of being less knowledgeable about a subject than their children. Many of today's adults are unfamiliar with how computers work and seem even to rebel against them out of a fear of losing their job to technology. However, society is inundated with computers in the homes, schools, and workplaces.

Consequently, it is imperative that schools teach children about computers in order for them to best be able to function successfully in a society that depends on technology for handling information and solving complex problems. The term "computer literacy" has been deemed as the catch phrase to describe this realm of computer information. To some educators, if a child can define byte, BASIC, disk, and data, plus tell you that banks, airports, scientists, and tax collectors use computers, then the child is computer literate. Other educators believe that one must be fluent in several programming languages such as BASIC, LOGO, or PASCAL in order to be classified as computer literate. However, the most comprehensive and widely accepted definition of computer literacy is " . . . the ability to use suitably programmed computers in appropriate ways to assist in learning, handling information, and solving problems, and the ability to make informed judgments about social and ethical issues involving computer and communication systems." (Hunter, p.9) One

important way to promote children's computer literacy is to teach word-processing skills. Furthermore, a word processor is an important tool in teaching children the writing process.

Teaching writing is not simply teaching students to form letters and adhere to grammatical rules; teaching writing involves teaching the process of skillfully combining components in order to communicate thought processes on paper. (Solomon, p.2) Obviously, there are many approaches to teaching writing. One approach, entitled the POWER approach, is appropriate for all age levels and types of writing. POWER is an acronym that stands for Pre-write, Organize, Write, Evaluate, and Revise. POWER is also a method of teaching writing that easily lends itself to using the computer as a tool. (Solomon, p.9)

Pre-writing is any thoughts that go into deciding what a piece of writing will be about. Pre-writing can be done individually, in groups, or with the aid of the computer. There are programs that will help the child with pre-writing methods such as branching, brainstorming, and free writing in order to collect thoughts and develop a focused idea and plan for the paper. One such pre-writing program to aid the child in free writing flashes a message on the screen if ten seconds pass without the student entering any words. (The student is instructed to continuously write his thoughts and not to worry .about punctuation.) For some children , this program becomes a repitition game with the object being to avoid having the warning "Please keep writing" appear on the screen.

(Klein , p.318).

The next step in the writing process is to organize one's thoughts and develop a plan for how to clearly and succinctly express these thoughts. The typical mode for organizing one's thoughts is through the use of an outline. However, children can organize their thoughts in other ways and are doing so when they decide how they will tell their story or describe something. Once again, there are programs available to aid the student in this step. Incidentally, it is important that some type of pre-writing tutorial program is being used if the computer is to be involved in these first writing steps. A blank terminal screen seems to be even more ominous than a blank white sheet of paper.

Writing is actually putting one's organized ideas into sentence form. The word processor is excellent for this next step because the child can key in his thoughts as quickly as possible and not be distracted by making mistakes. Editing both initial characters and entire sentences and paragraphs is simple on a word processor. The scenario of a child erasing words on his paper so many times that he becomes frustrated and rubs a hole right through the piece of paper is no longer necessary if the child utilizes the word processor. In fact, one 12-year-old child commented that "using the computer is a lot more interesting than just writing on paper. Besides, it seems to make you want to do more. It isn't like just sitting there writing so much your hand is going to fall off." (Collins,p.42)

The next step in the POWER approach is to evaluate, or read for improvement, the piece of writing. If he waits at least a day after writing the rough draft, the student will be better able to judge the clarity and impact of the combination of his words. The student also needs to look at a hard copy ( a printed copy ) of the document that is being worked on in order to properly evaluate it. One disadvantage of the word processor is that only a small part of the document shows up on the screen at one time, so it is important to have a hard copy of the writing to look at when analyzing the entire structure of the paper. Poor screen quality can also hamper readibility of word-processing. For some reason, when students see a typed copy of their work they are also much more able to recognize their errors than if they had been analyzing a hand-written copy.

After the child has had a chance to evaluate his own work, another form of evaluation could be used: peer evaluation. Peer evaluation can easily be initiated through the use of the word processor. First of all, children can pair up when keying in their papers. This pairing up might also need to occur if an extremely slow typist needs assistance from one of his more efficient peers. This partner approach provides a natural opportunity for both students to reevaluate their work as it is being keyed in. More importantly, the use of a printer enables the teacher to easily make multiple copies of drafts, even anonymously, so that the students can practice evaluating each other's work. Furthermore, if the work is being evaluated

by more than one student, multiple copies allow each evaluator to look at a fresh copy of the paper without having to read or be influenced by someone else's comments or corrections. Although the students will tend to be initially concerned with surface aspects of each other's text such as spelling and punctuation errors, as evaluators they will eventually begin to look more closely at the content of the writing and how it was presented. (Collins, p.43)

The final step in the POWER approach to writing is to make changes or revise. Research shows that students are much more willing to make changes on a piece of work that is created on the computer than work which is hand written. In fact, it has been estimated that 240% more revision occurs on word-processed papers than on written copies. (Knapp, p.184) Further study found that children made 91% of their revisions while composing at the computer as compared to only 75% of changes made while composing utilizing pen and paper. (Knapp,p.6) "Without the recopying penalty, students can easily insert or delete information at any point in their texts. Watching words, phrases and sentences jump around the screen at their command, they seemed to appreciate the fact that effective writing is a dynamic process." (Collins, p.43)

While revising word-processed papers, children also learn to see that language is malleable. As children type and retype words and phrases to convey the same thought, they learn to view composing, writing, and revising as one interdependent process. And, by learning that writing is an

interdependent process, the child ceases to expect his writing to be perfect the first time. Pen and paper discourages corrections; a computer encourages corrections.

Many sophisticated word processing programs include features to help the writer revise the paper. A common feature of these writer's helper programs is a spelling checker. Some spelling check programs simply identify words not in the computer's dictionary while other programs may go so far as to suggest alternate spellings for the word. Incidentally, student's spelling will actually improve by using a word processor. If a child is unsure of the spelling of a word, he can no longer get by with writing a sloppy letter that could resemble two different letters. Consequently, the student is forced to make a choice as to which letter is correct, which may result in increased dictionary usage. The important thing to remember about editing programs is that it is still the writer's responsibility to make changes in the text.

Critics may claim that editing software replaces important interaction between the student and the teacher. On the contrary, revising "on-screen" increases student/teacher interaction for several reasons. First of all, the student using the word processor is much more willing to take the time to edit his paper. Many lazy students will be hesitant to ask for help while editing hand-written papers because it means they will have to physically re-write the paper. Therefore, the final handwritten paper that the student turns in may not have been properly evaluated. Secondly, a student who edits his

own word-processed writing before asking for teacher assistance has a stronger feeling of ownership towards his paper and will accordingly want to improve it for his own feeling of success. Lastly, teachers will be less hesitant about suggesting revisions to their student's word processed papers knowing that it will be simple for the child to key in the changes. The word-processed work also becomes much more the student's sole work because the temptation of a teacher to mark on the student's rough draft (particularly in red pen) is all but removed until the child has submitted his final draft.

For the teachers whose children are turning in typed writing assignments, a new dimension of assessment is brought about. Objectivity of grading significantly increases when evaluating word-processed papers in that the teacher is no longer forced to "decipher" a child's writing and is therefore able to concentrate more intently on the structure and development of the paper. For example, the teacher will no longer have to decide if the student meant to spell a word with an "a" or with an "o". And, no matter how much teachers deny that they have any bias against poor handwriting, it seems apparent that grading will be less subjective when all of the children's composition is in the same printed form. The teacher can also utilize the power of anonymously grading the students' word-processed papers to further increase objectivity. When evaluating the student's word-processed papers, the teacher no longer has to make exceptions to length

requirements because of ambiguous directions. If the students are told to write a one-page story on a word processor, the teacher can assign a print size and line length without any misunderstanding. The child who used to resort to writing with large letters and lots of space between words to fulfill a length requirement is out of luck!

An obvious component of teaching children to use word processors encompasses teaching them typing skills. Typing used to be the cornerstone of high school business education classes. Today, the responsibility for teaching typing skills has filtered down to the elementary school. A basic problem with the concept of teaching children in elementary school to type is that their hands are not large enough and their fine motor skills are not refined enough to master touch typing until they are in the 4th or 5th grade.(Klein,p. 74) However, children can press letter keys without possessing the coordination needed to write letters by hand and may become competent typists before they learn to hand write well. Moreover, children enjoy learning how to type because it gives them a feeling of control over a machine. Young children who have not developed their fine motor skills yet may be unable to form letter shapes accurately, but with the touch of one button, they are able to type a perfectly shaped letter.

There are many activities that younger children can "do" to begin mastery of the keyboard such as learning the "home row". Fortunately, there are many programs that have been developed to assist the classroom teacher with this task. In

fact, there are two types of software to teach children keyboarding skills:

> 1) programs that build children's skills in letter and number recognition, alphabetizing, directional skills and problem-solving as well as helping children to learn the keyboard;
>
> 2) programs whose sole purpose is as a drill and practice to teach touch typing.

Several of the typing tutorial programs would even appeal to the video arcade fanatics in the classroom because they are modeled after popular games such as "Pac-Man".[TM] (Klein,pp. 774-776)

Young students are not the only students who would benefit from the experience of forming a perfectly shaped letter for the first time with the word processor. Handicapped students have had a whole new world opened up to them with respect to their writing through the use of the word processor. The handicapped student suddenly finds himself in control of the legibility and arrangement of the letters which leads to increased self-esteem towards the writing process. The POWER approach to writing similarly is an excellent approach to use with handicapped students since the emphasis is placed on thinking first and revising later. The handicapped child feels no pressure to write something perfectly the first time and the word processor will wait infinitely for the student's corrections and revisions.

For the handicapped student who has physical limitations that make it difficult to type, modification equipment can be installed to make typing possible on a word processor. For example, there are typing sticks or pointer rods that can be strapped to the child's hands or to his head if he has low or no control over fine muscle skills in his fingers. To further aid the student, devices are available that will turn on the computer and load software with a minimum of movement required. Oftentimes, these attachments will respond to sucking of blowing into a plastic tube.

For those students who have some control over their fingers, there are special keyguards that sit on top of the keyboard and enable the user to rest the heel of his hand on the keyboard while poking his fingers through the holes of the device to reach the keys. (Knapp,p.189) The EKEG keybaord is a special keyboard that is expanded and has flat keys that are spaced two inches apart on a flat, plastic surface to prevent the student from mistakenly hitting the wrong key. (Knapp, p. 190) In order to likewise save the handicapped student some effort, some programs will further allow the user to select from a collection of words and phrases with minimum movement. The program then assembles these words and phrases into sentences that can be stored or printed. (Knapp, p. 189)

Although hearing impaired students need little modification of equipment in order to communicate through the word processor, visually impaired students need a

considerable number of devices to effectively use the word processor. The opportunities for the visually impaired student to communicate with and through the word processor are hindered only by the rate of advancements made in technology. It is becoming more and more affordable for the visually impaired student to buy a special printer that will convert text into braille. Some advanced system's printers are able to edit in braille and to further convert the braille into a form suitable to be used with a speech board to produce voice output. The braille text can then be transmitted over phone lines or satellite relay. To further aid the visually impaired student when entering text, most word processing programs allow the user to increase the point size of the lettering. Many programs allow the user to work with letters as large as 5 1/2 inches tall. (Collins, p.42) The visually impaired student is provided with an unequaled opportunity to independently communicate through the word processor.

Two other types of special students that the word processor easily caters to are the gifted and talented child and the learning disabled child. Although both groups benefit equally from utilizing the word processor, the gifted and talented child benefits in a less complex manner. The word processor provides the gifted and talented child a means for further extension of his already developed writing skills. The gifted and talented child will feel free to write more complex and lengthy papers when utilizing the word processor without having to be burdened with the cumbersome task of rewriting

after editing. Inevitably, the word processor will present a challenge to the gifted and talented child in that he will want to master the intricacies of the word processing program.

For learning disabled students, those who have a large discrepancy between their achievement and their IQ, the word processor can be an invaluable tool. The LD student can gain confidence in that he can manipulate and "fix" typed words before anyone begins to evaluate them. The computer is infinitely patient and often can provide positive feedback that the child may not have previously received. And, since many LD students lack motivation, word processing may provide the missing incentive for the children to achieve in writing. LD students will particularly benefit from attaining a marketable skill. This skill may give them an opportunity to pursue a career they may not otherwise have been able to pursue if they were forced to rely on hand writing.

In the journalism profession, people speak of "the power of the printed word". I think this phrase also applies to word processing and children. There is something about seeing one's own writing in print that immensely encourages one to improve. Children who see their own writing in print for the first time are shocked; they can not believe that they actually wrote something that looks that good. Inevitably, children then want to take home their printed papers to show their families, particularly those students whose families are not computer literate. Parents may even pay more attention to the word-processed work than a hand-written copy. Students are

also more likely to want to see their word-processed work displayed on bulletin boards because there is no attention. paid to the the writer's print quality. Consequently, the poorer writer is able to concentrate more on meaning and his ability to communicate with others, since he is freed from placing disproportionate importance on the appearance of his paper. (Collins,p. 42)

Using a computer-based communication network in the school also opens up new doors in terms of written communication among students all over the world. With the use of modems, a child in Maine can write a story about living in an Atlantic harbor and a child in California can write a paper in return about living on the Pacific coast. Once again, this could provide opportunities for children to do peer revision: the two students on opposite sides of the country could evaluate each other's papers. Moreover, the handicapped child can communicate in an equal manner to other children on a computer network since no feelings of pity would be conjured up for the child's inability to hand write clearly.

Computer networks also open up doors for handicapped students in that these students can receive on-line services that will provide them with the opportunity to independently research information in encyclopedias, newspapers, and magazines. The children's interest in communication will increase when they are able to do the research unaided.

Computer networks may also build a new level of communication between the school and the home. Students

fortunate enough to own a computer system could connect into the school system through the use of a modem. Teachers would be able to transmit messages to parents without relying on the child to carry a note home to their parents that arrives crumpled and dog-eared, if at all.

In order for children to benefit from the value of word processing, teachers must first choose appropriate software. When choosing word processing software for their students, many teachers are unsure as to the merits of buying software designed for adult writers versus software designed especially for the young writer. There are obviously benefits to buying each type of software which depend on the goals and objectives of each teacher.

Word processing programs for young children such as Bank Street Writer TM are initially easier to learn how to use. Most programs designed for children are menu-driven. The child is required to memorize very few operating procedures on a menu-driven program. The available features and commands are displayed on a menu so the child can easily make the appropriate choice. Many children will even be able to teach themselves the program. And, since the child is required to remember very few commands, he is free to concentrate on the writing process. Unfortunately, menu-driven programs are slower and oftentimes do not offer the advanced word processing features an older child might need. Another feature in a word processing program for young writers is a separation of the writing and editing functions.

This separation forces the child to switch from one mode of operation to the other which prevents him from mistakenly erasing words and lines with the slip of a finger. Unfortunately, a separation of the writing and editing functions in the program may also cause the child to view the two processes as totally separate instead of being integrated.

Word processing programs designed for adults such as Word Star $^{TM}$ and Applewriter $^{TM}$ obviously include many more advanced functions such as split-screen editing and footnoting. One of the most common features of a word processing program designed for adults is that it is command-driven. The user of a command-driven program must know the codes for performing functions. Typically, the list of functions and corresponding codes can be viewed by the user at any time, but the goal is to memorize the key commands, such as holding down the control key and the "s" key to save the program. Initially, it takes the user time to learn the commands, but once the code is learned, functions such as centering and underlining are quickly and efficiently processed. Teaching children to utilize programs designed for adults would be beneficial in that all of the members in the school could communicate using the same program. Furthermore, the child would be able to communicate outside of the school environment.

A few word processing programs such as Magic Slate $^{TM}$ are versatile enough to be used by both young and adult writers. These programs provide different levels of use so

that a child can grow into the program's more advanced features at his own pace. Furthermore, teachers can aid students in memorizing codes for command-driven programs by using mnemonic phrases.

Seymour Pappert, the developer of the LOGO programming language, says: "I believe that the computer as a writing instrument offers children an opportunity to become more like adults, indeed like advanced professionals, in their relationship to their intellectual products and to themselves. In doing so, it comes into head-on collision with the many aspects of school whose effect, if not whose intention, is to "infantalize" the child." (Pappert,p. 31)

The value of using the word processor in the elementary school classroom is now being recognized outside of the school environment. In fact, teachers are now being held accountable if they are not teaching their students word-processing skills. Teaching word-processing promotes computer literacy which is a must in today's technological society. Most importantly, teaching word processing significantly increases a child's interest and motivation to become a better writer. One technique , entitled the POWER approach, is a very effective means for teaching writing utilizing the word processor. The word processor opens up a new dimension in the entire writing process, in that it teaches students that writing is an interdependent process of composing, writing, and re-writing.

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