Computers in Elementary and Special Education

by

Margo Sailor
Computers have been used for many years in business and industry. They have been used in education since the 1960's. However, it has only been within the last three years that computers have become cheap enough and, therefore, practical enough to include them in schools all over the country.

Computers in education definitely opened a new technological door to many people. In 1981, one-half of the United States school districts owned one or more computers. This is quite an increase over previous years, but it still shows we have a long way to go to put computers in every school and, ultimately, in every classroom. By the end of 1982, the numbers of schools using computers had increased sixty percent. I am certain that reports at the close of 1983 will again show a rapid increase in the number of computers used in the schools.

Computers in education play very versatile roles. There are many different types of computers designed to do many different things. In this paper, I will try to present some of the major ways computers are being used to help educate. By no means is this an exhaustive list. New technology in these areas is developing at such a fast rate that it is difficult to keep up with the latest discoveries. These are my findings up to the end of the year 1983.

As we all know, there have been thousands of new discoveries associated with the computer. There are quite a few of these which lend themselves especially well for use in special education. These can and probably are being used in other areas of education, but they have begun to play an important role in teaching the physically and mentally handicapped.

Computer-Based Exploratory Learning Systems (CBELS) are programs which emphasize the use of the computer to help students learn by manipulating their environment instead of just answering questions others have presented. Much of the software being created today only requires the student to answer questions. This is a grave under-use of the computer. Workbooks or ditto sheets can do the same thing at a cheaper cost. Computer-Based Exploratory Learning Systems are mainly used for reading and language development, because at
this time, these are the most effective systems. They closely parallel
the normal stages of language acquisition and they can be easily
adapted to special learning needs. These systems have brought about
a significant change in the education of many handicapped individuals.

Computer-Based Exploratory Learning Systems are especially
appropriate for handicapped students because: 1) They help students
learn language in a way that is similar to normal language develop­
ment. Students learn language by using it to interact with others;
2) They are based on students' manipulative interests. Students with
moderate to severe handicaps respond better to objects and activities
they can manipulate; 3) They promote the growth of autonomy and an
active attitude. These systems reinforce active exploration of the
students' surroundings. Studies show that an active attitude towards
communicating is closely linked to language proficiency.

Computers hold special appeal for handicapped students because
they give the students control over their surroundings which many
of them rarely experience. Computers can make the students feel
successful at something. Success often comes in small amounts and
infrequently for these students. We need to quickly build on this
success and work for better learning. Some examples of Computer-Based
Exploratory Learning Systems are The Talking Typewriter, LOGC, CARIS,
Terak Writing Laboratory, and the BBN Mail System. I will explain
each of these in the following paragraphs.

The Talking Typewriter is the oldest Computer-Based Exploratory
Learning System used with handicapped students. The first system of
this type to be used was created by a man named Moore. He used four
stages to promote growth in reading and writing. In stage one, the
student types in any letter and the computer sounds out the letter
name. In stage two, the computer asks the student to type in particular
letters. Only if the student types in the correct letters will the
computer give a response. Stage three is where words are introduced
to the student through guided spelling. The computer responds only
when the correct letters are pressed. In stage four, reading is
finally introduced using stories printed by the computer.

LOGO is a general purpose computer language which is very
simple to operate yet powerful. It was developed fourteen years ago
by Seymour Papert and his associates at Massachusetts Institute of Technology Artificial Intelligence Laboratory. Students can give the computer simple commands to draw any picture they desire. This is very reinforcing for physically handicapped students who could otherwise not draw.

CARIS stands for Computer-Animated Reading Instruction System. This system uses brief computer-animated cartoons to introduce reading to students. The students generate simple noun-verb sentences from a lexicon of available words. The computer then creates a brief cartoon acting out the meaning of the sentence. In this way, students are able to acquire meaning from printed words.

The Terak Writing Laboratory allows students to do their writing on Terak Wordprocessors where they can easily edit and rewrite sections without rewriting the entire paper. This method is gaining use in writing for all students because of its great motivating factor. The students are much more eager to write using wordprocessors than they are by traditional paper and pencil methods.

In the BBN Mail System, students write letters to each other via computers. This method helps to expand students' writing and communication skills. It too has met with great success because of the motivating factor.

Two other computer-based technology systems used in special education are the Reading Machine and the Intelligent Videodisc for Special Education Technology (IVSET). The Reading Machine employs microprocessor, optical scanning, and voice synthesis technology to convert printed material of all different type sizes and styles to synthetic full-word English speech. This machine can read books, magazines, periodicals, typewritten letters, reports, and other printed documents. The user of the machine can temporarily halt, back up to hear several lines again, skip forward, and locate a particular word and spell it out. The user can also control the volume, speech rate, pitch, and scanning of different page formats such as columns and tables. As you can see, this machine is very versatile and would be a great aid to someone with visual problems. The cost is the big drawback here, as in many of the systems.

The Intelligent Videodisc for Special Education Technology
presents material in a multi-sensory approach. The user is presented with stimulus pictures and text on a TV monitor screen accompanied by aural commands. The student interacts with the program by touching the correct responses on the screen. The program is touch sensitive and can, therefore, tell if the response is correct or incorrect. If the response is incorrect, the program branches off for instructional review. The multi-sensory approach used in this system would help make learning much more efficient for some students by using several different modalities to teach through simultaneously.

There are other systems used with the handicapped. One of these even has the means to help students compose music by voice alone. I previously listed and explained a few types of communication systems. There are many more types which are more sophisticated and are used solely for communication with others. However, I must say here, in all fairness, that using computers for communication is still not very efficient. The effort it takes to operate the majority of the systems is too great for the severely handicapped. It is difficult to motivate them to communicate because it does take so much energy. The need for newer systems which are simple and require little effort to operate is large. We must create these "ideal" systems before communication using computers is practical.

These first few pages have been devoted solely to computers in special education. Several of them could be used in other areas and I have only touched on some of the main ones. The rest of this paper will primarily be directed at using computers in education in general. I will, however, cite a few examples where specific methods work especially well in certain subject areas. I have also included a couple of computer programs where I feel it may help clarify or demonstrate what I am discussing.

Computers are mainly used in two different ways in the classroom. These are general classifications. They can be used as either a tool or as a medium.

As a tool, the computer is much more flexible than when it is used as a medium. When used as a tool, the students use the computer to solve designated problems or problems the students design themselves. This generally takes the form of computer programming.
The students are given a problem and they must write a program to solve it. As you can see, this is much more flexible and has unlimited possibilities for use in the classroom.

Debugging the programs to make them work strengthens students' problem solving skills and it also creates a positive attitude toward error by allowing the students to correct the problems by themselves. It also helps the students to see how an error affects an entire process and what happens when it is fixed. Many people question the value of teaching students programming skills. Their main argument is that most students will not need to program computers as adults. I, on the other hand, think that many students as adults will be required from time to time to program or at least know how the process works. Even if this were not so, I think that students develop many other skills such as problem solving so as to justify the teaching of programming skills to those students who are mentally able to grasp them. There are other ways to teach problem solving skills, but the computer has a built in motivator to make teaching of the skills easier. Why not use the easiest means to teach, especially if it is just as effective or more so?

As a medium, the computer uses previously designed programs, which can be either commercial or teacher made. These programs fall into one of five types: 1) Drill and Practice; 2) Tutorial; 3) Educational Games; 4) Simulations; 5) Problem Solving.

The Drill and Practice program is the most common type of program and is the easiest to create. The programs simply provide practice of previously learned material. It could be used in most any subject area. I have included three programs of this type. The first one is a spelling drill which gives the student hints if the wrong letters are typed. (See Appendix A). The second program is a multiple choice math one that deals with money. The student would be practicing recognition of coin equivalence (See Appendix B). The third program is a timed multiple choice test dealing with holidays and months. The students must answer the questions within a certain set time limit. This program is rather generic in that it could easily be changed to fit any subject matter. The only real difference between this program and the previous one is that this one is timed (See Appendix C).
Tutorial programs assume the role of the teacher in that they present new material in a programmed format. Students move step by step and are tested along the way to see if concepts are being mastered. These programs generally have the ability to branch to remedial or review segments if testing results show it is necessary. Some programs even allow the user to branch to advanced segments if the testing shows the material is too easy for the user.22

Educational Games are games which are designed to develop general problem solving methods and strategies while maintaining high interest and motivation.23 These types of programs have received quite a bit of criticism as to their educational value. While it is true that many of the games in use today contain violence and competition, there are games which were designed, and do in effect, enhance cooperation. Many also allow the students to create and help develop social and emotional growth.24 It is this latter type which could be used in the classroom to further education. In my opinion, the first type are junk and can be thrown away. Cooperation Maze (Edutek Corporation, 1982) requires that two players work together to move a cursor through a maze to reach a goal.25

Games such as Mix and Match(Apple, 1982) and Adlibs(Rakio Shack, 1982a) give the students the freedom to create. Mix and Match allows the students to create their own puppets by choosing different faces, bodies, and legs. In the game Adlibs, students insert words into preprogrammed stories or students can create their own stories.26

Making Decisions(Phillip Roy, Inc., 1982) gives students the opportunity to make rational decisions and helps then apply these to the real consumer world. Self Concept and Work(Phillip Roy, Inc., 1982) helps students prepare for the working world.27

I have never seen any of these games in action so I am not able to attest to their value. This was only a small sample so I feel certain there are games out there that are educationally sound. One must look through a lot of "junk" in the process, though.

Simulations are programs which lead students through real or fictitious situations in which the students normally would not be able to participate. These include activities such as piloting a plane or running a nuclear reactor. These programs allow students
to assess and respond to situations as if they were actually happening. These help students develop greater skills in reasoning and problem solving, not to leave out the learning from experiencing the situation itself. These types of programs are especially beneficial in the social studies where much of the content taught is not immediately available on a real life basis.

The use of simulations in vocational education opens up many interesting and exciting avenues. Students can experience many different vocations in a more concrete way than before. An example of such a program would be to have students calculate the housewiring needs for a particular house. This is very intimidating and time consuming on paper. The computer makes it less intimidating and more of a challenge. Two other simulation programs which work well in the social studies curriculum are presented in Appendix D.

In my opinion, these types of programs are one of the most valuable, if not the most valuable, at the present time in education. They present situations to the students which require skills to solve that students will need in their daily lives. The students are able to learn more about past and present events or situations in a close to real life manner. We all know that people learn best by experience. It is said to be our best teacher.

Problem Solving programs are the fifth type of program. Several of the other types of programs I have listed require the student use problem solving skills to complete the programs. They, however, are not designed as primarily problem solving programs. It was very difficult for me to find examples of programs labeled as problem solving. I think this is because it is a skill which is used in so many of the other types of programs.

One type of problem solving program is that which is made for students to test hypotheses. The student is instructed to make a hypothesis and then support it with different kinds of evidence. The computer then works with the student to help test the hypothesis by exceptions.

There are also problem solving programs which allow the user freedom to be rather creative. In Appendix E, I have shown an example of a program format which creatively helps a student formulate
relevant research questions. It solves a problem in that it helps a student separate relevant from irrelevant information.

At the present time, the five categories of computer programs I have just described covers all types. The programs in each category range from very easy to extremely complex. In the near future there may even be more types of computer programs. I, for one, certainly hope and expect so.

I would now like to present some ideas on why I believe computers should be an active part of every classroom learning program. There are two different terms used in writing today about computer instruction. One is computer-based instruction (CBI) and the other is computer-assisted instruction (CAI). They both mean essentially the same thing, but I prefer the term computer-assisted instruction and, therefore, will use that term in my explanations.

My first and biggest plus for using computer-assisted instruction in the classroom is in light of the tremendous motivating factor it possesses. The continuous interaction with the computer is very motivating for students. Students also enjoy the computer because of the individualized attention and the immediate feedback it gives. Students know the results of their performances immediately which helps them learn better. They also motivate by lessening the fear of a wrong answer. In many programs, the students work at their own individual levels which almost ensures "failure-free" mastery of concepts. Enough said about the computers' motivating factors.

Computer-assisted instruction also improves on the quality of education. Computers help to individualize instruction which cuts down on the normal amounts of instruction time. Since the students' learning is self-paced, there is an increase in teacher effectiveness and the quality of instruction. Computer-assisted instruction helps students learn faster and retention of material after working with a computer is as good or better than retention after traditional instruction. Research has recently shown that these factors have contributed to a rise in achievement scores. Elementary students who received computer-assisted instruction in drill and practice showed performance gains of one to eight months over students who had only received traditional instruction. The study did not
say over what period of time these students made such gains and I am somewhat skeptical.

There are many students in the classroom today who have minor learning problems. These problems can sometimes be attributed to the student's inability to attend to relevant material. Computer programs can be designed to cue students to the relevant material by the use of arrows, boxes, lights, buzzer noises, etc... In some cases, this may be all the student needs to help him or her learn better.

Computers can also be used to improve students' response rates. Timers can be put into programs to help a student speed up his answering process. This should be carefully planned and used. Students who respond too quickly without thinking and give wrong answers can be given visual and/or auditory clues to help them stop and think before they answer.

For students who have short-term memory problems, material can be presented in a variety of ways in a process of overlearning. This could be done by traditional methods too, but the computer might add new light to the task at hand. Often, students with learning problems need to be presented with the same concepts several times before they are learned. The computer presentation might just be the one to teach because of students' high interest. An example of a spelling format using this overlearning technique is shown in Appendix F.

Many people argue against the use of computers saying it separates children instead of bringing them together. To counteract time students spend working alone on the computer, have students work with a partner on the computer to solve a problem or play a game cooperatively. This works well with shy students or those who have trouble making friends. It may also help to create friendships.

Computer-assisted instruction has other advantages over traditional methods. It could be the answer to providing instructional equality in rural areas where small enrollments limit the course offerings. This has been a problem for a long time. Children growing up in rural communities have very little chance of getting an education compatible to children in an urban community. As a result, rural students have difficulty competing with city students.
for college placement and jobs unless, of course, the students want to remain in their rural community. Self-instructed courses taught with the aid of a computer could greatly help such students compete.

Computers could also be used for homebound students. The teacher could send and receive homework via the computer. This would save teacher time and keep the homebound students up with their classmates.

Three additional advantages of computer-assisted instruction are: 1) it frees the teacher from a lot of clerical work; 2) a permanent record of each student's learning is compiled; 3) students can be kept busy doing constructive work because they are working at their own pace.

I have stated what others and myself see as advantages to using computer-assisted instruction in the classroom. I do not want anyone to think that computers are to be used as teacher substitutes. They are to aid the teacher like any other filmstrip, tape recorder, or overhead projector. The advantages are numerous and as I see it, far out weigh the disadvantages of cost and retraining of educators.

Now, I must address the biggest problem in using computers in the classroom at the present date. That problem is the lack of appropriate software. There are many problems with the currently marketed software. This is mainly due to the fact that teachers are not in on the designing of the programs. When this changes, so will the quality of the software. Current problems include: 1) programs may be over simplified; 2) the teacher has to supply the students with a great deal of background before they can use the program; 3) inadequate visuals; 4) the range of issues in the programs is too limited; 5) most programs do not allow for group interaction; 6) technical limitations such as having to start an entire simulation over if a player wants to change an assumption.

In addition to remedying the above problems, we need to give the user more flexibility within the programs. In Appendix G, I have included a math program of my own design which allows the students to choose what type of problems they want to do. It also lets them choose a different type of problem when they have completed the first type of their choosing. Commercial made programs should have more versatility than this, but it is a basic example.
For these reasons, many teachers have decided to write their own programs. Most of them are the drill and practice type as I have shown, because they are the easiest to write. In Appendix H, I have shown a table which gives a checklist for designing enjoyable educational programs.\textsuperscript{50} In Appendix I, you will find another set of guidelines to consider when designing software.\textsuperscript{51} I have included them both because they have some different yet good ideas.

However, you will eventually want to buy some of your computer programs. When that time comes, you will probably want some guidelines to go by. Remember, there is a lot of "junk" out there. Here is some advice from the experts: 1) Find a good dealer—be wary of buying software at bargain prices from catalogs. Look for a dealer who will let you preview the product or get you in touch with a teacher who uses the program. See the teacher and program in person, if possible. Ask the dealer what the policy is on replacing programs with bugs. Also, ask if the dealer will train you in using the product, if necessary; 2) Is the program "user friendly?" Can you quickly get into and out of a program? Is it easy to restart the program? Does the student have any control over the program (eg. speed, readability level, difficulty of problems, etc...)? Can the students correct their answers?; 3) Is it educationally sound? The program should build concepts, present a logical sequence of skills, and operate quietly. It should also have branching capabilities and pretests and/or post tests; 4) Does it fit your school's curriculum? The program should compliment the original curriculum goals; 5) Does it make use of the computer's capabilities? It should do more than traditional methods can, for the most part; 6) Does it know its audience? Is the program "childproof" or will it "crash" if a wrong key is pressed? Will it appeal to the level of students you plan to use it with?\textsuperscript{52} This is a list of some very reasonable expectations for the software you buy. Please keep them in mind.

What will the future bring in the way of computers in education? There will be many changes in the coming decade, but the speed at which these changes will occur depends primarily on three things: 1) How swiftly America moves to a knowledge-based economy; 2) How much educators resist the change of their roles and the teaching structure; 3) How many resources society uses to retrain educators
and develop quality software.  

Some of the predicted changes are not surprising while others may rock a few boats. Much of the material now taught through group use of a textbook will be taught using hand-held computers. This method will cost less than textbooks, allow for even greater individualization, use less space, and be more easily updated.

Students will learn faster because they can work at their own rate. More advanced subject matter will be taught in the time it now takes to teach the basic skills and teachers will be able to concentrate on the more advanced and diverse skills that a computer can not (yet) teach effectively. This will be a great turning point for gifted and above average students. However, it will ultimately help all students learn better.

Along with the greater use of computers, there will be a greater need for emphasis on human interaction and interpersonal skills when the teacher is working with the students so that the students' affective growth will not be stunted. This is a big point of concern for many people, but it need not be. We know how to avoid the problem of creating little "robots" so all we have to do is work for it.

New methods in testing will also occur. There will be new testing forms to replace the old standardized ones. Tests will begin with questions of minimum difficulty and will gradually increase in difficulty as the student answers more questions correctly. If the student misses a question, the computer will select a less difficult question. Students will be able to work at their own level and not feel frustrated during testing which probably makes the test results even worse. It will be a more accurate way of testing, so state the researchers for the future of computers in education.

In this paper, I have tried to give an overall view of where computers stand in education as of the end of 1983. Most of it has been factually based, but I have also presented some of my own ideas on the topics. Both are clearly marked and I believe no confusion will be made between the two. I realize that the paper covers quite a bit of territory, but that was my intended purpose. The issue of computers in the classroom is so new that I wanted to present many aspects of it. I strongly support the use of computers in education.
and will continue to learn more so that I can use them to the best extent to teach in the future. The technology is here to stay and it can only continue to improve. It is my hope that other educators will not drag their feet too long in protest. It is really the children we are letting down if we do not proceed quickly.
Appendix A

Spelling Drill

5 REM PROGRAM BY M. SAILOR
10 CLS
20 PRINT @20,"WORD HINT"
30 FOR N=1 TO 800:NEXT N:CLS
40 PRINT "FOR THIS GAME, I WILL FLASH A WORD ON THE SCREEN"
50 PRINT "VERY QUICKLY. AFTER THE WORD DISAPPEARS, I WILL ASK"
60 PRINT "YOU TO TYPE IN THE WORD YOU SAW. IF YOU DON'T GET"
65 PRINT "IT AT FIRST, I WILL START TO GIVE YOU CLUES."
80 INPUT "ARE YOU READY TO START(TYPE YES OR NO)";H$;
90 CLS:IF H$="YES" THEN 100
95 GOTO 80
100 FOR R=1 TO 10:READ A$:X=0
110 PRINT @280,A$
120 FOR N=1 TO 150:NEXT N:CLS
130 INPUT "WHAT WAS THE WORD";W$
140 IF W$=A$ THEN 200
145 X=X+1:IF X=LEN(A$) THEN 180
150 PRINT "SORRY, THAT WASN'T CORRECT. HERE IS A HINT."
160 FOR N=1 TO 800:NEXT N:CLS
170 PRINT @280,LEFT$(A$,X):FOR N=1 TO 200:NEXT N:CLS:GOTO 130
180 PRINT "THAT WAS INCORRECT. THE WORD WAS ":A$:FOR N=1 TO 800:NEX
190 T N:CLS
200 NEXT R:GOTO 300
210 S=S+1
220 CLS:PRINT CHR$(23):PRINT @470,"GOOD JOB!":FOR N=1 TO 500:NEXT
230 N:CLS
220 NEXT R:GOTO 300
250 DATA HELP,TRAIN,PLAY,FUNNY,JUMP,CAMPER, COLOR, BALL, MANY, SA
260 LT, ZOO
300 PRINT "YOU ARE FINISHED. YOU GOT "S" WORDS CORRECT."
310 PRINT "THAT IS " S/10 *100" PERCENT CORRECT.";STOP

* This is a program of my own design which operates on the Radio Shack TRS-80 computer.
Appendix B

Money

5 REM PROGRAM BY M. SAILOR
10 CLS:PRINT @217,"MONEY"
15 FOR X=1 TO 500:NEXT X:CLS
20 INPUT "HELLO, WHAT IS YOUR NAME";N$
30 PRINT "NOW "$N$, I AM GOING TO TEST YOUR MONEY SKILLS."
35 PRINT "THIS IS A MULTIPLE CHOICE QUIZ. PRESS IN THE "
40 PRINT "LETTER OF THE CORRECT ANSWER FOR EACH QUESTION."
45 PRINT "THERE ARE FIVE QUESTIONS."
50 INPUT "PRESS ENTER TO START";E
60 CLS:PRINT "HERE COMES THE FIRST ONE.";M=0
70 FOR N=1 TO 500:NEXT N:CLS
80 FOR L=1 TO 5
90 READ A$,B$,C$,D$,E$,F$,G$
100 DATA 1. QUARTER,2 DIMES AND 1 NICKEL,4 NICKELS
105 DATA 1 DIME AND FIVE PENNIES,A,G00D JOB!
110 DATA SORRY-THE ANSWER IS 2 DIMES AND 1 NICKEL
115 DATA 2. DIME,1 QUARTER,10 PENNIES,1 NICKEL AND 2 PENNIES
120 DATA B,TERRIFIC!,NO-1 DIME EQUALS 10 PENNIES
125 DATA 3. NICKEL,5 PENNIES,5 DIMES,2 QUARTERS
130 DATA A,VERY GOOD,OOPS!-A NICKEL EQUALS 5 PENNIES
133 DATA 4. QUARTER,2 DIMES AND 1 PENNY
135 DATA 3 NICKELS,3 NICKELS AND 10 PENNIES,C,SUPER
140 DATA SORRY-A QUARTER EQUALS 3 NICKELS AND 10 PENNIES
145 DATA 5. DIME,2 NICKELS AND THREE PENNIES
150 DATA 2 NICKELS,1 NICKEL AND THREE PENNIES,B,FANTASTIC
155 DATA NO-1 DIME EQUALS 2 NICKELS
160 PRINT @261,N$ " TYPE IN THE LETTER OF THE ANSWER THAT";
165 PRINT " EQUALS A:"" 
170 PRINT @340,A$
175 PRINT:PRINT @473,"A. "B$
180 PRINT:PRINT @537,"B. "C$
185 PRINT:PRINT @601,"C. "D$
190 INPUT R$
195 IF R$=E$ THEN 230
200 M=M+1
205 PRINT @835,GS
210 FOR N=1 TO 900:NEXT N:CLS:NEXT L:GOTO 260
230 CLS:PRINT @465,CHR$(23)F$
240 FOR N=1 TO 500:NEXT N:CLS:NEXT L:GOTO 260
260 PRINT N$ " YOU GOT "5-M" OF THOSE RIGHT." 
270 FOR N=1 TO 500:NEXT N:CLS
280 IF 5-M>4 THEN 330
290 RESTORE:PRINT "LET'S TRY THAT AGAIN."
300 FOR N=1 TO 400:NEXT N:CLS:GOTO 60
330 STOP

* This is a program of my own design which operates on the Radio Shack TRS-80 computer.
Appendix C

Multiple Choice Test

10 CLS: PRINT @275, "MULTIPLE CHOICE TEST": FOR X = 1 TO 400: NEXT X: CLS
20 PRINT "THIS IS A TIMED TEST. YOU WILL ONLY HAVE A FEW"
25 PRINT "SECONDS TO ANSWER EACH QUESTION SO ANSWER QUICKLY."
30 PRINT "TYPE IN THE LETTER OF THE ANSWER."
40 INPUT "ARE YOU READY TO START (TYPE YES OR NO)"; H$
50 CLS: IF H$ = "YES" THEN 70
60 GOTO 40
70 FOR G = 1 TO 5: READ A$, B$, C$, D$, E$
90 PRINT @200, "IN WHAT MONTH DO WE CELEBRATE "; A$
100 PRINT @350, "A. " B$
110 PRINT @478, "B. " C$
120 PRINT @606, "C. " D$
140 FOR F = 1 TO 400: IF F = 400 THEN PRINT "OUT OF TIME - A POINT FOR ME "; FOR X = 1 TO 600: NEXT X: CLS: CS = CS + 1: NEXT G: GOTO 400
150 K$ = INKEY$
160 IF K$ = "" THEN 200
170 IF K$ = E$ THEN PRINT "NICE JOB! YOU GOT IT RIGHT.": FOR X = 1 TO 5
00: NEXT X: CLS: PS = PS + 1: NEXT G: GOTO 400
180 IF K$ <> E$ THEN PRINT "SORRY, THAT'S WRONG. A POINT FOR ME. THE 
CORRECT ANSWER IS "; E$: FOR X = 1 TO 1400: NEXT X: CLS: CC = CC + 1: NEXT G: 
GOTO 400
200 NEXT F: GOTO 400
300 DATA HALLOWEEN, JANUARY, MARCH, OCTOBER, C, VALENTINE'S DAY, FEBRUARY, JULY, MAY, A, CHRISTMAS, NOVEMBER, SEPTEMBER, DECEMBER, A, EASTER, FEBRUARY, APRIL, MAY, B, INDEPENDENCE DAY, JUNE, JULY, AUGUST, B
400 PRINT "YOU ARE FINISHED. THE COMPUTER HAS "CC + CS" POINTS.
410 PRINT "YOU HAVE "PS" POINTS."
420 IF CC + CS > PS PRINT "THE COMPUTER WON.": STOP
430 IF PS > CC + CS PRINT "YOU WON": STOP

* This is a program of my own design which operates on the Radio Shack TRS-80 computer.
Appendix D

Oregon
Grade level: 3-6

Oregon simulates a trip along the Oregon Trail from Independence, Missouri, to Oregon City, Oregon in 1847. The student reenacts the journey of a family of five who attempted to complete the 2000-mile trip in five to six months. The family had $700 and a wagon at the beginning of the trip. They must spend their money on oxen, food, ammunition, clothing and miscellaneous supplies. The family tries to succeed in reaching the Oregon Trail.

One of the strengths of this program is its extensive documentation, part of which describes in detail the assumptions underlying the simulation model. The program has high motivational value and is a well-known (and often copied) simulation.

Geography Search
Grade level: 5-12

Geography Search puts groups of students on ancient ships searching for the New World. Through the computer, they navigate using the sun, stars, ocean depth, climate, and trade winds. Workbooks provide instruction in the use and meaning of these variables for student teams to sail their ships. Students keep detailed notes on the ship's location and their surroundings, based on sailing reports provided by the computer.

One of the pluses of this program is its appreciation for the logistical and instructional challenges facing the teacher. Considerable time is spent discussing room set up and organization of student groups. Unfinished sessions can be saved on disk and continued in future class meetings.
Appendix E

A Creative Way to Help Students Formulate Relevant Research Questions.

Instructional Objective:
Given a passage, the student will be able to formulate relevant research questions.

(Students are allowed to choose from a menu of listed programs. Suppose the student chooses:)

(Nature and Wildlife)

You have selected a passage in nature and wildlife. Read the entire passage carefully. Were there any words you did not understand?

(yes)

Name one.

(Environment)

(The program takes the word indicated by the student to formulate a question.)

What type of environment do alligators live in?

(Water and hot temperature)

You said water and hot temperature. Does that describe an environment?

(yes)

Now do you know what environment means?

(yes)

So, what is an environment?

(A type of place where an animal lives.)

Now, formulate your own research question, using the word environment. Be sure to ask a question that can be answered by reading the passage.

(Do polar bears always live in an environment of cold temperatures?)

(Computer responds):

I don't know. Can you answer your question?

(Student answers)

(no)

(The program continues with a similar routine. The program limits the student to identify five unknown words. If more than five are not known, the student is directed to talk to the teacher. If the student initially did not have any problems with the word meanings, the program would have routed the student to a higher step in the instructional sequence.)

Good for you! Now that you have read the passage and understood the word meanings, let's look at the following questions:

What two animals would you find on an African safari?

(lion, tiger)

Did you get your answer of lion and tiger from the passage?

(yes)

Think again. Where in the passage did you find your answer of lion and tiger?

(nowhere)

Okay. So where did you come up with your answer?

(A book I read.)
Formulate a research question that can be directly answered from the passage.

(Why does Africa always have a hot climate?)

Can you answer your question from the passage?

(Yes)

Good! What is the answer?

(It's near the equator.)

Point out the paragraph and line number of your answer.

(Paragraph 3, line 4)

Good job! You can find your answer directly by reading the passage. This means that the question you formulated is relevant to the story. The story was used as the source for formulating and answering your research question.

(The program continues with a similar routine.)
Appendix F

Spelling-Overlearning Process

1. Have the student trace dotted lines of the word with a light pen on the screen.

2. With a model of a word on the screen, have the student fill in the missing letters of the word.
   Examples- _at, c_t, ca_, __t, etc...

3. Repeat step number two, only this time there is no model of the complete word present on the screen.

4. Have the student choose correctly spelled words from a list of distractor words.

5. With a model of a word on the screen, have the student type in the word several times.

6. Repeat step number five, only this time there is no model of the word present.

7. Have the student type in a word to fill in a blank in a sentence.

8. Student types a sentence containing the word.

9. Lastly, the student writes a sentence containing the word on paper.
Appendix G

Math Drill

5 REM PROGRAM BY M. SAILOR
10 CLS
20 PRINT @475,"MATH DRILL"
30 FOR X=1 TO 500:NEXT X:CLS
40 INPUT "TYPE YOUR NAME";N$
50 CLS:PRINT @220,"HELLO "N$".
55 PRINT@260,"CHOOSE THE TYPE OF PROBLEMS YOU WANT TO DO."
57 PRINT @324,"AFTER 10 PROBLEMS YOU MAY CHOOSE A DIFFERENT"
58 PRINT "TYPE"
60 PRINT @390,"1. ADDITION"
62 PRINT @454,"2. SUBTRACTION"
63 PRINT @510,"3. MULTIPLICATION"
66 PRINT @712,"TYPE THE NUMBER OF THE PROBLEMS YOU WANT";
67 INPUT N:CLS
68 ON N GOTO 70,100,125
70 FOR F=1 TO 10
72 A=RND(3)-1:B=RND(10)
75 PRINT A"+"B=";
78 INPUT AR
79 CLS
80 IF AR<>A+B THEN 95
82 AC=AC+1:G=RND(3)
84 ON G GOTO 85,87,90
85 PRINT@476,"SUPER";FOR X=1 TO 500:NEXT X:CLS:NEXT F:GOTO 500
87 FOR F=1 TO 100
88 PRINT "FANTASTIC";
89 NEXT F:CLS:NEXT F:GOTO 500
90 FOR T=1 TO 100:I=RND(500):PRINT@1,"RIGHT";NEXT T:CLS
92 NEXT F:GOTO 500
95 PRINT "NO, THE CORRECT ANSWER IS "A"+"B"="A+B
97 FOR X=1 TO 500:NEXT X:CLS:NEXT F:GOTO 500
100 FOR F=1 TO 10
102 A=RND(3)-1:B=RND(10)+1
105 PRINT B"-"A=";
107 INPUT SR
109 CLS
110 IF SR<>B-A THEN 120
112 SC=SC+1:C=RND(3)
114 ON C GOTO 115,116,118
115 FOR T=1 TO 100:PRINT "RIGHT";NEXT T:CLS:NEXT F:GOTO 520
116 PRINT CHR$(27):PRINT @470,"TERRIFIC";FOR F=1 TO 500
117 NEXT F:CLS:NEXT F:GOTO 520
118 PRINT @130,"G";PRINT @200,"R";PRINT @270,"E";PRINT @340,"A"
119 PRINT@410,"T";FOR X=1 TO 500:NEXT X:CLS:NEXT F:GOTO 520
120 PRINT "NO, THE CORRECT ANSWER IS "B"-"A"="B-A
122 FOR T=1 TO 600:NEXT T:CLS:NEXT F:GOTO 520
125 FOR F=1 TO 10
127 A=RND(3)-1:B=RND(10)
130 PRINT A"\*"B=";
132 INPUT MR:CLS
134 IF MR<>A*B THEN 150
136 MC=MC+1:C=RND(3)
138 ON C GOTO 140,142,144
140 FOR O=1 TO 20:PRINT@476,"CORRECT":CLS:NEXT O:NEXT P
141 GOTO 540
142 PRINT CHR$(23):PRINT @476,"RIGHT"
143 FOR T=1 TO 500:NEXT T:CLS:NEXT P:GOTO 540
144 PRINT @476,"GREAT GOING":FOR T=1 TO 500:NEXT T:CLS:NEXT P
145 GOTO GOTO 540
150 PRINT "NO, THE CORRECT ANSWER IS "A"\*"B="A*B
155 FOR Z=1 TO 800:NEXT Z:CLS:NEXT P:GOTO 540
500 PRINT "FINISHED. YOU HAD "AC" ADDITION PROBLEMS RIGHT"
510 GOTO 550
520 PRINT "FINISHED. YOU HAD "SC" SUBTRACTION PROBLEMS RIGHT"
530 GOTO 550
540 PRINT "FINISHED. YOU HAD "MC" MULTIPLICATION PROBLEMS ";
545 PRINT "RIGHT":GOTO 550
550 INPUT "WOULD YOU LIKE TO PLAY AGAIN (YES OR NO)";RR$      
555 IF RR$="YES" GOTO 50
560 IF RR$="NO" THEN STOP

* This is a program of my own design which operates on the Radio Shack TRS-80 computer.
Appendix H

Checklist for Designing Enjoyable Educational Programs

Challenge

Goal
Does the activity have a clear goal? If not, is it easy for the students to determine goals of appropriate difficulty for themselves?
Are the goals personally meaningful?

Uncertain Outcome
Does the program have a variable difficulty level?
Determined by the student?
Determined automatically, depending on the student's skill?
Determined by the opponent's skill?
Does the activity have multiple goal levels?
Scorekeeping?
Speeded responses?
Does the program include randomness?
Does the program include hidden information, selectively revealed?

Fantasy
Does the program include an emotionally appealing fantasy?
Is the fantasy intrinsically related to the skill learned in the activity?
Does the fantasy provide a useful metaphor?

Curiosity

Sensory Curiosity
Does the program include random and unusual effects?
As decoration?
To enhance fantasy?
As a reward?
As a representation system?

Cognitive Curiosity
Does the program include surprises?
Does the program include constructive feedback?
Appendix I

Necessary Attributes to Consider in Designing Courseware for the Microcomputer

Generic to Instructional Design

1. Target audience specified
2. Learner entry competencies specified
3. Rationale, goals, and objectives specified
4. Objectives stated behaviorally
5. Objectives in terms of the learner
6. Objectives include higher-order skills
7. Learners informed of objectives
8. Range and scope of content adequate to achieve program's intents
9. FreInstructional strategies used:
   - Pretests
   - Advance organizers
   - Title at beginning of unit
10. Instructional text formatted for easy reading
11. Concept learning employed in instructional approach
12. Vocabulary used appropriately for learner
13. Graphics imbedded in content
14. Graphics used appropriately
15. Demonstration of the exercise provided
16. Teacher's manual provided
17. Instructions clearly stated for student
18. Evaluation components provided

Necessary for Design of Courseware

1. Curriculum role used:
   - Adjunct
   - Mainline
   - Management only
   - Other
2. Mode of interaction employed:
   - Drill and Practice
   - Tutorial
   - Game
   - Simulation
   - Problem-Solving
3. Student sequenced through the content:
   - Nonlinear
   - Varied by teacher/student
4. Instructional text formatted for screen display
5. Graphics imbedded in the content
6. Graphics used appropriately
7. Cues and/or other prompts used
8. Action occurs on the screen
9. User control granted to learner
10. Computer-Managed Instruction employed
11. Feedback used appropriately
12. Records stored on magnetic devices for future retrieval
13. Content designed to be altered
14. Random generation used
15. Packaging designed for component parts
16. Teacher's manual and Student Manual provided
17. Technical design used:
   - Quick response time
   - Quick loading time
Footnotes


2 Ibid.


4 Ibid.

5 Ibid., pp.127.


7 Geoffrion, p. 126-127.


9 Geoffrion, p. 127.

10 Ibid., p. 128.

11 Ibid., pp. 128-129.

12 Ibid., pp. 129-130.


14 Ibid., p. 109.


16 Ibid.


18 Ibid., p. 367.


21 Ibid., pp. 124-125.
22 Ibid., p. 125.
23 Ibid., p. 126.
26 Ibid., p. 244.
27 Ibid., pp. 244-245.
28 Bennett, p. 110.
30 Ibid., p. 324.
33 Ibid., p. 9.
34 Anderson, p. 367.
35 Gallini, p. 9.
36 Budoff and Hutten, p. 126.
40 Kulik, p. 19.
41 Grimes, p. 51.
42 Ibid.
43 Ibid., p. 52.
44 Ibid., p. 53.
45 Ibid.
46 Joiner, Vensel, Ross, and Silverstein, p. 16.
47 Ibid.
48 Goldenberg, p. 55.
50 Malone, p. 246.
54 Ibid., p. 22.
56 Ibid., p. 24.
Bibliography


