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AUTHOR East, Philip; Moursund, David
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ABSTRACT

A review of the literature on the use of calculators and computers in instruction is presented. Topics covered include: (1) statements of goals for the instructional use of calculators and computers; (2) position statements; (3) computer manpower supply and demand; (4) a technical overview; (5) calculators in elementary schools; (6) computers in high school education; (7) computer science courses for teachers; (8) a selection of articles from the Oregon Council for Computer Education; (9) a review of "Creative Computing Magazine"; and (10) a listing of information sources. (MP)

CALCULATORS & COMPUTERS
IN THE CLASSROOM

CALCULATORS & COMPUTERS IN THE CLASSROOM

Prepared by:

Philip East
Dept. of Computer Science
University of Oregon
Eugene, Oregon 97403

David Moursund
Department of Computer Science
University of Oregon
Eugene, Oregon 97403

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INTRODUCTION

All educators are aware that calculators and computers exist and are widely used outside of education. They realize that these machines have had an impact upon instruction and have the potential to have a much larger impact. How should calculators and computers be used in instruction? That is what this paper is about! To save words, in what follows we often use the word computer to include both calculators and computers.

To begin, please be aware that the computer field in not a subfield of mathematics. It is a very large, interdisciplinary field of potential interest to all educators. Computers are important in business, social science, and science. The instructional use of computers is often divided into three categories:

* Teaching About Computers: This includes teaching computer literacy, computer programming, and computer science.

* Teaching Using Computers: In many situations computers are an educationally sound and cost-effective instructional delivery system.

* Because Computers Exist: This is a "catch-all" category, reflecting the impact of computers upon other academic fields. Some of the content of these disciplines needs to change to reflect the existence and widespread availability of computers.

MODEL STATEMENT OF GOALS

There are literally thousands of possible goals for the instructional use of computers. (See the Tri-County Course Goals Project discussed later.) Leaders in the computer education field generally recommend that a school district adopt the following goals.

1. All students should become calculator- and computer-literate. They should have a working knowledge of the capabilities, limitations, applications, and effect of calculators and computers within a framework of their general education.

2. Use of computers as an aid to instruction should occur when it is educationally and economically sound.

3. More advanced training in computer science should be available to students having the interest and academic potential to benefit from it.

NCTM POSITION STATEMENTS

Calculators and computers are especially important in mathematics education. Thus the National Council of Teachers of Mathematics has formulated position statements with respect to these machines. The following are copied from page 468 of the May 1978 issue of The Mathematics Teacher that is devoted to calculators and computers.

USE OF MINICALCULATORS

The following position statement was approved by the Board of Directors in 1974.

> With the decrease in the cost of the minicalculator, its accessibility to students at all levels is increasing rapidly. Mathematics teachers should recognize its potential contribution as a valuable instructional aid. In the classroom, the minicalculator should be used in imaginative ways to reinforce learning and to motivate learners as they become proficient in mathematics.

In the January 1976 issue (pages 92-94), the Instructional Affairs Committee offered a variety of problems to indicate how minicalculators could be used in the schools. This committee is now in the process of reviewing the status of minicalculators in the schools and will be making recommendations to the Board of Directors.

The Board of Directors has adopted the following goal for the Council: "To encourage the development and evaluation of curriculum and instructional materials incorporating the use of the hand-held calculator and other computing devices." A regularly updated bibiography, "Minicalculator Information Resources," is available free on request from the NCTM Headquarters.

COMPUTERS IN THE CLASSROOM

The following statement was approved by the NCTM Board of Directors in September 1976.

> Although computers have become an essential tool of our society, their diverse and sustained effects on all of us are frequently overlooked. The astounding computational power of the computer has altered priorities in the mathematics curriculum with respect to both content and instructional practices. Improvement in computer technology continues to make computers, minicomputers, and programmable calculators increasingly accessible to greater numbers of students at reasonable costs.
>
> An essential outcome of contemporary education is computer literacy. Every student should have firsthand experiences with both the capabilities and the limitations of computers through contemporary applications. Although the study of computers is intrinsically valuable, educators should also develop an awareness of the advantages of computers both in interdisciplinary problem solving and as an instructional aid. Educational decision makers, including classroom teachers, should seek to make computers readily available as an integral part of the educational system.

Mathematics Education in the Future

by Dr. Gary Bitter
Arizona State University
Tempe, Arizona 85281

This 54-page booklet reports on a study done by Dr. Bitter during his 1976-77 sabbatical leave. He designed a questionnaire and mailed it out to 550 mathematics educators. The purpose was to obtain their feelings and expectations on mathematics education in the future. Quoted below are four short sections from the Preface.

Instrument

The questionnaire consisted of 16 items. Questions asked what changes might occur in the future of the elementary, secondary, or university level of mathematics education. Other questions focused on "The Basic Skills Era," textbooks, teaching equipment, teacher responsibilities, Piaget, and impacts on the future of teaching mathematics. The data were analyzed by percentage analysis and the Spearman analysis of rank-order.

Findings

The overwhelming response to the survey predicted calculators, computers and research on learning to be the most influential sources of change for the future of mathematics education. Research, national assessment programs, accountability and teacher education will also influence mathematics education.

"The Basic Skills Era"

Many educators claimed basic skills are not sufficient for problem solving and the future. Educators disagreed as to what emphasis would be placed upon basic skills. They did feel, however, that the "Basic Skills Era" would decline in the years 1978 to 1987.

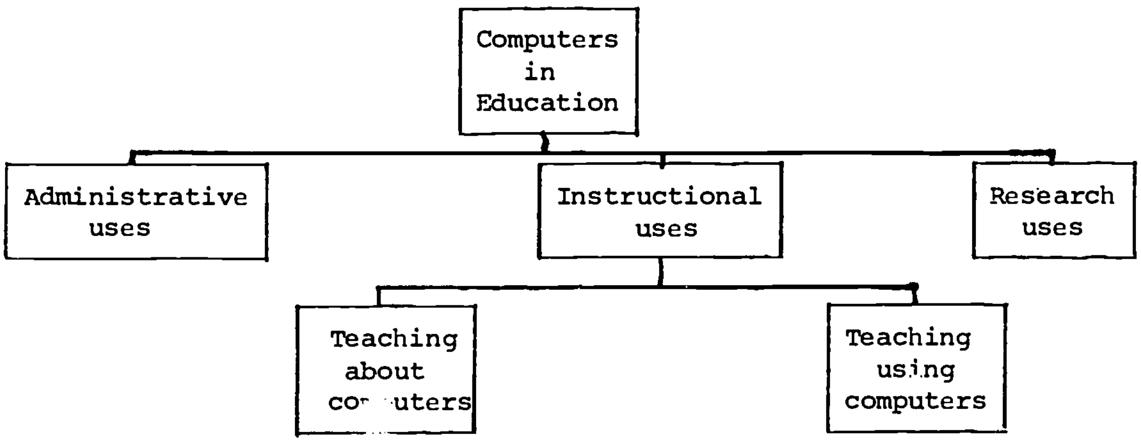
Equipment of Future Math Education

Most educators anticipate calculators and computers to become an integral part of future math education. Videotapes, math labs with manipulative materials and microprocessors are also expected in the programs. Filmstrips, overhead transparencies, chalkboards and textbooks will continue to be part of the math curriculum.

The report is based upon 350 returned questionnaires (64%). It is evident that the questionnaire was designed to encourage the expression of opinions on calculators and computers. The fact that these areas dominated in many of the response categories suggests that mathematics educators are well aware of this area, and that they feel calculators and computers will play an important role in mathematics education of the future.

COMPUTERS IN EDUCATION OVERVIEW

This section gives a brief overview of the educational uses of computers. The major emphasis is upon instructional uses. Material for this section is drawn mainly from Chapter II of Computers in Education Resource Handbook, edited by Dunlap and Moursund, published by the University of Oregon's Computer Science Department, 1977.



About 3% of the United States higher education budget is spent on computer hardware, software, and related personnel. This is roughly evenly divided among administrative, instructional, and research uses. At the precollege level educational use of computers consumes perhaps 1% of the national budget. There is very little research usage, and administrative usage far outweighs instructional usage.

Still, instructional usage is widespread and is growing rapidly. In Oregon well over 3/4 of secondary students are enrolled in schools that make some instructional use of computers. Calculators are commonplace in secondary schools, and many elementary schools own a classroom set. Perhaps 5%-10% of elementary schools make occasional instructional use of computers.

There are two common modes for the delivery of this instructional computing service. A school or school system may belong to a consortium which runs a medium scale timeshared computer system. METCOM, operating out of Multnomah ESD, and OTIS, operating out of Lane ESD, are the largest of these systems in Oregon. Each serves many dozens of schools and many many thousands of students. A large central computer system, and associated staff, provides an economy of scale in software acquisition and development. It facilitates dissemination of software and courseware, and is often a help in running inservice teacher education programs.

The microcomputer provides a second mode for the delivery of instructional computing services. Machines in the $500 to $2000 range are now used throughout Oregon at all educational levels. Their small size makes for easy portability, while their small cost brings them within the budget range of most schools.

Most microcomputers are programmable in BASIC and use a TV screen (most use black/white, but some use color) for output display. One can do some very nice computer graphics work on these machines. Music generators are available, and interface with scientific equipment is possible. Other languages, such as FORTRAN and PASCAL, are just now becoming available on inexpensive microcomputers.

Teaching About Computers

In April 1972 the Conference Board of the Mathematical Sciences published "Recommendations Regarding Computers in High School Education." It recommended that a computer literacy course be a required part of junior high school education in the United States. It was at about this time the Oregon Council for Computer Education was getting well established. The OCCE has recommended that computer literacy be a goal for pre-college education. The short-lived Oregon Department of Education's Commission on Computers in Education established this same goal.

Thus there is a strong support for secondary schools to offer a computer literacy course. Are You Computer Literate? by Billings and Moursund, dilithium Press, 1979, gives a good overview of the content of such a course. A computer literacy course may include some computer programming and perhaps a little more sophisticated computer science. Courses in computer programming are fairly common in Oregon's secondary schools. A "solid" year course in computer science, akin to the high school chemistry or physics course, is not yet well established. Over the next decade this is likely to become a standard course offering in larger high schools.

Teaching Using Computers

Teaching using computers can occur at any grade level and in any subject matter area. It may be simple minded drill and practice -- much like an automated flash card system. More sophisticated computer-assisted learning situations involve interactive tutorials and computerized simulations.

Currently computer-assisted learning is most used in situations where education is expensive, such as in special education, medical schools, and at some military installations. However, recent declines in the price of computer equipment make computer assisted learning cost effective at every educational level. It is now evident that computerized instruction in both the home and in the school will grow very rapidly during the next decade.

COMPUTER MANPOWER - SUPPLY AND DEMAND - BY STATES

The title of this page is the title of a booklet by Dr. John W. Hamblen, who is generally considered to be this country's leading expert in that field. He has recently completed the Third Edition - 1979 of this publication. It is a comprehensive study of jobs in the computer field, education needed to fill these jobs, and numbers of students being graduated from various training programs. Most of the positions require some college education. The job outlook for positions requiring a bachelor's degree or more is excellent. The material quoted below is from the Preface to Hamblen's publication. Order information is given at the bottom of the page. Note that the booklet is only 40 pages long.

> In the preface of the first edition I stated that the cause of many of the problems associated with computer usage is the "overutilization of undereducated people." The reason being, of course, that properly educated people have not been available. Bootstrapping by training existing personnel and pirating whatever others centers had trained was the only way that staff could be obtained during the late fifties and the early sixties. The late sixties saw the tremendous growth in the one and two-year programs aided by large infusions of federal monies via the Office of Education programs. The production of these programs crested around 1972 at a peak of nearly 28,000 during that year dropped to about 20,000 for 1975 and are now up again to over 27,000. The seventies might well become known as the decade of the recognition of the value of the college graduate to effective and efficient computer usage. Based upon my estimate of need and the present average rate of growth (about 16%) in the production of graduates of four-year programs it will take nearly twelve years to match the need and production.
>
> The main point here is that it will be sometime before we need to worry about a "glut" in the market for four-year graduates in the computer related areas. At the master's level, the rate of growth was about half that of the four-year production rate prior to 1976-77. However 1976-77 production was below the 1974-75 estimates. At the doctorate level we also have a drop in production below 1973-74 levels. Production of doctorates is only 26% or about 1 out of 4 needed.

Hamblen's study covers employment as a data entry clerk, computer operator, applications programmer, systems programmer, computer analyst, and various management positions. About 1 1/2% of all employment in the United States (and a corresponding percentage in Oregon) fall into these categories. The price of the booklet is $15 to Educational Institutions and Government Agencies on prepaid orders. (It is higher to all others.) Make checks payable to:

INFORMATION SYSTEMS CONSULTANTS
R.R. 1, Box 256-A
St. James, MO 65559

TECHNICAL OVERVIEW

Electronic calculators and computers are products of very sophisticated technology. While one needs very little technological knowledge to use them, one needs a considerably higher level of knowledge to understand them. This section is a very brief introduction to the technology and vocabulary of the field. It is a summary of Section C: Technical Overview appearing in the Computers in Education Resource Handbook (1977 Edition), edited by Dunlap and Moursund and published by the University of Oregon's Computer Science Department. Some material is also drawn from Problem Solving with Calculators, Billings and Moursund, dilithium Press, 1979.

The word computer, as used in this paper, covers the full range of electronic digital calculator and computer equipment.

\$5	\$500	\$50,000	\$5,000,000
Simple pocket calculator	micro-computer	mini-computer systems	very large computer systems

Notice that the price range of the equipment under consideration spans six orders of magnitude -- a factor of a million. But the very cheapest calculator has many features in common with the most expensive computer. Each is a machine for the input, storage, manipulation, and output of information. Each makes use of electronic circuitry to accomplish these tasks.

Calculators

Calculators range in price from about \$5 to \$500. Very good quality "name brand" 6-function machines with memory are available in the \$10-\$20 range. The functions are addition, subtraction, multiplication, division, square root, and percent. The best buy for elementary school and junior high school students is generally considered to be a 5 or 6-function machine with 4 key memory and liquid crystal display (LCD). Such a machine meets all of the calculational needs of pre-algebra level students, and a set of batteries will generally last for a year or more of intensive use.

More expensive calculators have many more functions and/or are programmable. The trigonometry and/or business functions found on these machines are useful to some senior high school students. Programmable calculators tend to find most of their use in the hands of professionals, although occasionally their use is taught in a high school.

Computers

Computers differ from calculators in that they have a full alphabetic keyboard and can deal with a full range of alphabetical and numerical symbols. Computers can work with words as well as with numbers. All computers have the following:

1. Input unit(s). Input may be via simple typewriter-like keyboard or by a wide variety of more sophisticated equipment.

2. Output unit(s). Output may be via inexpensive TV screen, typewriter, printer, or by a wide variety of more sophisticated equipment.

3. Memory. Often divided into two categories (primary and secondary), a computer memory stores instructions and data. Primary memory is of limited capacity, is very fast, and is relatively expensive. Secondary memory can have very large capacity, is relatively inexpensive, and tends to have a slower rate for storage and recall.

4. Central Processing Unit (CPU). This is part of the machine that can interpret and carry out a detailed step-by-step set of instructions (a program) at a very high rate of speed.

5. Language(s). Every computer is constructed to "understand" some language (its own machine language) and generally each brand or model of computer has a different language. Software (that is, programs) can be written so that a computer "understands" a wide variety of languages such as BASIC, COBOL, FORTRAN, and PASCAL.

Software

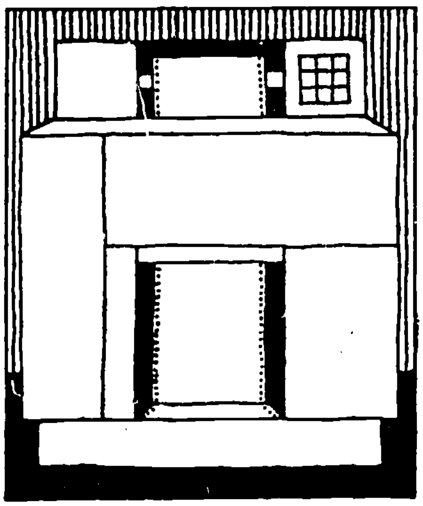
Software means programs -- detailed step-by-step sets of directions written in a language understandable to a particular computer. A computer without software is useless. Thus almost every computer is sold with some software. Nowadays the computer software needed to accomplish a particular task can well cost several times what the hardware does. Software is expensive, but essential.

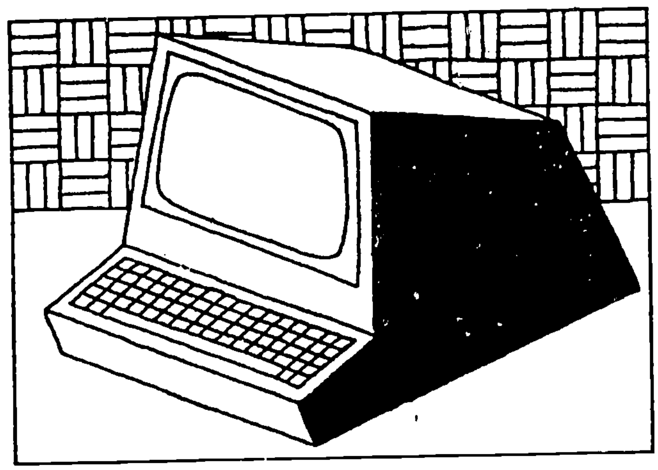
There are two general categories of software. Systems software is designed to help a user interact with a computer system. It includes language translators, for computer languages such as BASIC, COBOL, FORTRAN, and PASCAL. These computer languages were created by humans and are not natural or inherent to any computer. Rather, they exist for a particular computer only if someone has written a translator program (a piece of software) that translates from them into the particular machine's machine language. Each translator is a large, sophisticated (expensive) program, and a different one is needed for each language a machine is to understand.

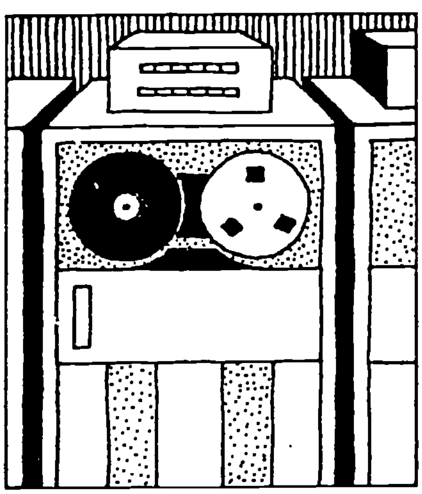
Applications software is designed to help solve specific problems of interest to computer users. Many thousands of programs have been written and are commercially available. But finding a program to fit one's specific needs (to solve a particular problem one has in mind) is often difficult. Because of differences between machines, languages, and dialects of languages, applications software is not easily interchangable or transportable between different brands/models of computers. This is a very major problem in the computer field.

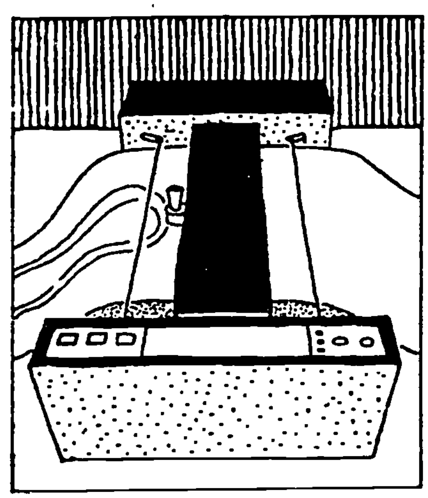
Summary

It is a relatively simple matter to make a decision to buy an inexpensive calculator, or even a classroom set of them. Such calculators are easy to understand and easy to use; no software is needed. But buying a computer is another matter. The range of equipment (hardware) and software is immense and the potential for error is large. The more one intends to spend, the more knowledge one should have. A few hours of study may suffice for purchasing a calculator, a few weeks of study may suffice for purchasing a microcomputer, but several person-years of study are often needed to make an adequate decision on a million dollar computer system.









CALCULATORS IN ELEMENTARY SCHOOLS

Numerous studies have been done on the use of calculators in the elementary school. Probably the largest, and certainly one of the most recent, is a study funded by the National Science Foundation and carried out during 1977-78. A paper titled "Calculators in Elementary Schools" by Grayson Wheatley, Richard Shumway, Terrence Coburn, Robert Reys, Harold Schoen, Charlotte Wheatley, and Arthur White will soon appear in the Arithmetic Teacher. Two other papers describing the research and results have been submitted to other professional journals. What follows consists mainly of selected quotations from pre-publication copies of the three papers. The research provides strong support to people wanting to use calculators in the elementary school and in the home (parent-child interaction).

> During the 1977-78 school year the National Science Foundation funded a project to assess the impact of calculators on the learning of mathematics in the elementary school. Specifically, the question was asked, "Will there be any difference in knowledge of basic facts, computational skill, or understanding as a result of calculator use?" Efforts were also made to assess the motivational effect of calculators.
>
> Design of study
>
> The design specified research sites in Indiana, Iowa, Michigan, Missouri, and Ohio. At a school in each state, two classes at each grade level, 2-6, were randomly assigned to the calculator or no-calculator treatment. (The calculator, no-calculator designation applied to the first semester.) In all, 1500 pupils, 50 teachers and five schools participated in the study.
>
> In early October, 1977 students in the project schools were pretested on mathematics achievement and attitudes. Stanford Achievement Tests were selected for assessing mathematics performance on concepts, computations, and applications. The appropriate grade level battery was administered, (Intermediate or Primary). A Basic Facts test was constructed by randomly selecting 20 facts from each of the four operations, e.g., 8+9, 7x6. A Likert Scale Attitude instrument was developed for measuring attitudes towards mathematics and towards calculators.
>
> In mid-October 1977, a two-hour calculator workshop for participating teachers was held at each school. Reference materials containing recommended calculator activities were made available to teachers of the calculator classes.
>
> Although teachers were encouraged to use calculators to teach concepts, problem solving, and basic facts, the teachers themselves made the decision as to when and how calculators were used in their classrooms. The percentage of time given to calculator use varied greatly from classroom to classroom. Some teachers at each grade level made extensive use of calculators while others made only limited use. On the basis of teacher reports and observations, the use of calculators was estimated to be 30% of class time. A mathematics educator (member of the research team) was present in each

school daily throughout the year to observe and instruct with teachers and pupils. Attempts were made to balance the time the mathematics educator was with teachers using calculators in their classes and teachers not using calculators.

In February 1978, fourteen weeks after introduction of calculators into the classes, all pupils were tested (without calculators) on the same topics as before. Additionally, tests were administered to measure estimation skills and performance on certain topics not typically taught at the grade level tested, e.g., addition of integers and decimals.

Following the fourteen week (October-February) period, treatments were reversed; the previous calculator classes no longer used calculators and calculators were made available for the previous no calculator classes. This design was planned as a safeguard so that compensatory activities could be provided if declines were noted in the February testing. Furthermore, from the schools perspective, it was desirable for all pupils in the study to have calculator experience. Since no declines were found in the February testing the March to May period was simply a time of calculator experience for half the sample. In May all pupils were tested on basic facts, computation and attitudes. The May testing was planned to monitor basic skills and attitudes.

As can be seen, this was a massive study (the NSF grant exceeded $200,000). Part of one report consists of quotations from some of the children involved. A few of them are given below.

"I liked to do it a little bit. I like calculators but I hate math. I have one of my own calculators."

"it was rille fun my Dad bote me A calculator on my Birthday it was Maysixth! it came with a booklit He side if I do the things in the booklit He Will buy me one like the Schools I rille have fun with Calculators."

"My fevorite thing to do with the calculator is add up numbers. Calculators are sometimes fun to use. Next year in mathe class I hope that we get to use them again. If I didn't have a calculator I would be sad because I like to a calculator in math. Also I use the calculator to practice my times. It was fun using the calculator in math. At home we have a calculator that I use."

"The calculator helped me to learn negative numbers. Because of the calculator I do better in math. The calculator is a great invention to me."

"I liked playing the calculator game. I didn't like the calculator because sometimes it didn't tell the right answer. It didn't help me very much in math. So the calculator wasn't so bad."

"I didn't think using them sometimes I think we shouldn't use them we don't learn anything in math exsept how we use them that I'm not against They were boring close to the end of school we used them on our study sheets and we didn't learn anything The only thing I liked about them was pressing the buttons know I like calculators I don't wish we could have them back, but I like them."

"I felt like I was CHEATING."

Results of the study are quite supportive of using calculators.

Children's contention that in using a calculator they were much better at computation was also supported by testing. All children performed 2-3 grade levels higher on advanced computational tests while using calculators. Since the calculator is a quick, efficient computational device the result is not unexpected.

The test data supported the generally positive comments children made about liking calculators. Attitude towards calculators was consistently very positive. By all measures most children enjoyed using calculators. Observations at all schools suggested children were consistently excited about using calculators.

One difficulty raised by children's comments which was unsupported by the data was some children's tendency to feel guilty when using a calculator -- in fact, so guilty that the use was associated with cheating. Certainly such feelings are reinforced to some extent by parents and teachers who sense that something must be wrong with such quick, efficient computation. However, the data provides no evidence that such guilt is warranted. One need not feel guilty using calculators for the study and learning of mathematics.

Conclusions

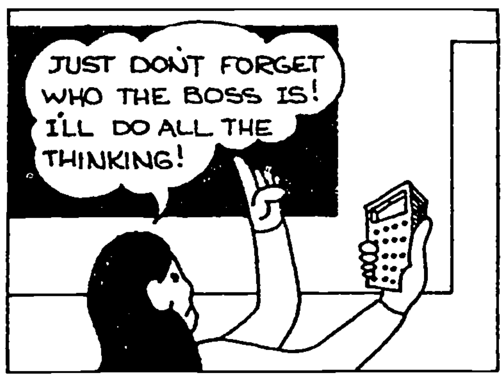
Widespread concern over the use of calculators by young children prompted a broad, year-long study of the impact of calculators on elementary school mathematics learning. In the context of the level of calculator use elementary teachers are likely to implement in the first year with calculators available for all children and limited supplementary materials for student use, the following conclusions seem warranted:

1. There are no measurable detrimental effects for initial first-year use of calculators for teaching mathematics in grades 2-6.

2. Children have a high, positive attitude toward using calculators in mathematics.

3. Children learn to use calculators for computation with 30 minutes of instruction and can perform computations much more successfully than children not using calculators.

Informal observations by site directors and teachers suggest that curriculum implications for calculators in elementary school could be dramatic. Presumably the results here will allow educators to begin developing and testing calculator use methods and activities with potential benefits to elementary school mathematics. The testing for detrimental effects should not end with this study. Not yet tested are the possible effects of longer (more than 14 weeks) and more intensive calculator use (greater than 30-40%). Such studies would be reasonable follow-ups and serve a public need.



CALCULATORS

There are approximately as many calculators in use in the United States as there are television sets. That is, most homes have one or more, almost all places of business use them, and they are now fairly common in schools. Their impact upon the curriculum varies widely with the school, school system, and/or the individual teacher.

Many studies have been done on the use of calculators in education. The study by Wheatley et al reported in this paper is a good example. But by and large educators tend to ignore these studies; instead, they make a "seat of the pants" decision based upon their own insights into the issue. This helps explain the unevenness of current usage. While most high schools now own a substantial number of calculators, some math and science teachers still don't use them. Most grade schools own a few calculators, but their use at this level is not yet common.

It seems likely that the use of calculators at all grade levels will gradually increase as more and better materials become available, as teachers become more knowledgeable, and as educators become convinced that they are a useful aid to education. The amount of material available is growing rapidly. Many mathematics textbook series now include calculator activities. There are now a number of books on calculators specifically oriented towards education. Some examples of materials are reproduced below and on subsequent pages. These all come from books published by dilithium Press, Portland, Oregon, and are reproduced with the permission of the publisher. They should be viewed as examples of the types of materials available rather than as endorsements of particular books.

Taxes in Taxes???

Naturally, many people believe that rich people should pay more taxes than poor people, since the wealthier ones have more money.

But sometimes this policy is carried to extremes. In one place I recently heard of, the tax rate was made the same as the number of thousands of dollars a person earns. For example, if a person earns $6,000, then his tax is 6% of that. But if a person earns $92,000, then his taxes are a whopping 92% of that.

What is the most you could have left after taxes, and how much would your income be to make that take-home page? What income would leave you the most money *after taxes*?

The above material is from the book Games, Tricks, and Puzzles for a Hand Calculator, by Wallace Judd.

Plus or Minus

Any number can play this fast-moving game of the "Buzz" variety. Players pass the calculator around, requesting the next player to change the number on display to something else through addition or subtraction. If the player makes an error or exceeds the time limit, he drops out of the game. The game continues until a sole survivor is identified.

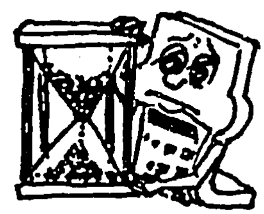
NUMBER OF PLAYERS: Two to ten.
APPROXIMATE TIME REQUIREMENT: Depending upon the players' computational skills, the game may last anywhere from a few minutes to a few days. We once had a game going for three days, off and on.
SKILLS INVOLVED: Ability to add and subtract two-digit numbers rapidly.
CHANCE FACTOR: None.
PLAY OF THE GAME:

(1) Players are seated around in a rough circle. The first player enters any two-digit number in the calculator and passes it to the player on his left. He then calls out another two-digit number.

Gavin is the first player. He enters 36, presses the plus key, gives the calculator to his neighbor Lillian and says, "Fifty one."

(2) The player receiving the calculator changes the number on display to the requested number through a single addition or subtraction. He does this within a count of 10.

As soon as Lillian gets the calculator, Gavin starts counting slowly to 10. Lillian trembles, drops the calculator, picks it up, plugs in 15, stabs at and (fortunately) hits the plus key and . . . (suspense) . . . 51 pops up in the display! (She faints.)



(3) The game continues with each player calling out a new two-digit number and passing the calculator to the neighbor.

Lillian calls out 27, passes the calculator to John and starts counting to 10. John performs the correct subtraction and passes the calculator to Ted with a request for 83.

(4) If a player does not complete the task within the count of 10, or if he does not get the required number, he drops out of the game. Before he leaves, however, he passes the calculator to the next person with a new request.

It takes Ted a count of 14 before he manipulates the number into 83. So he is eliminated from the game. Before he leaves the circle, however, he calls out 16, gives the calculator to Len and starts his count. Len gets flustered and subtracts 57 and gets 26 instead of 16. He is eliminated also, but passes the calculator to Jeff and requests 62.

(5) As the game continues, only those players who are not eliminated in the previous rounds participate in the subsequent rounds. The last remaining player is the winner.

The materials on this and the next two pages are from Games With the Pocket Calculator by Sivasailam Thiagarajan and Harold Stolovitch.

Triple Nine

Your opponent enters a three-digit mystery number in the calculator. You supply numbers to be added. Your opponent keeps a running total and tells you how many nines there are in the resulting totals. He also identifies one other digit without revealing its position. Your objective is to reach the total of 999 with the least possible number of trials.

NUMBER OF PLAYERS: Two.

APPROXIMATE TIME REQUIREMENT: Three to seven minutes for a game. Ten to fifteen minutes for a "match."

SKILLS INVOLVED: Addition and making logical inferences.

CHANCE LEVEL: Very little. Among advanced players the game becomes one of pure skill.

PLAY OF THE GAME:

(1) The first player enters a three-digit number (a three-digit number is a number from 100 to 999) in the calculator and tells his opponent that he is ready.

Vince punches in the mystery number 297, presses the plus key and says, "Ready!"

(2) The second player calls out a number which has one, two, or three digits in it. The first player adds this number to his original number. He then informs his opponent (a) how many nines there are in the total and (b) any other digit, but not its position.

Harold says, "Add 123." Vince does so and gets a total of 420. He says, "No nines and a four."

(3) The process of the opponent calling out a number, the first player adding it to the total and giving information about nines and one other digit, is repeated. Players keep track of how many turns are taken.

Harold says, "Add 555," hoping to change the four to a nine regardless of its position. Vince adds the 555 and get 975. He tells Harold, "One nine and a five." This is the end of round two.

(4) During any round of the game, if the total goes over 999, the first player returns to the previous total. No additional information about the digits is given to the opponent. This is counted as a round.

Harold guesses that the nine is in the hundreds place, though he is not sure of the location of the five. To make the maximum use of the situation, he asks Vince to add 44. When Vince does this, he gets a total of 1019! So he presses the minus key to cancel the last addition and says, "You went over." This is the end of the third round.

Harold is not upset because he has collected some useful information in the last round. His hunch about the nine in the hundreds place is confirmed. He also figures out that the tens digit is greater than five because only then could the total have gone over a thousand. Therefore, the five must be in the units place. He calls out, "Add four." Vince's total is now 979 and he responds with "Two nines and a seven."

Harold has the entire number now. To finish off the game, he says, "Add 20." Vince does so and announces "Three nines." The first game ends in five rounds.

(5) The game is played again with the roles reversed. The second player in the previous game now selects a mystery number and the other player tries to run it up to 999.

Here's the complete game when it was Vince's turn to guess:

Round 1. Vince begins by saying, "Add 123." Harold does this and announces, "No nines and a one."

Round 2. Vince figures out that the one cannot be in the hundreds place because Harold began with a three-digit number and, at Vince's request, added 123. So the "1" has to be in the tens or units place. Vince guesses the latter and says, "Add an eight." Harold does so and says, "No nines and a two."

Round 3. Vince takes a moment to process this information. Since he did not get a nine, the units digit was not the one. It must have been in the tens place. Obviously, it is now not a one because something must have been carried from the units place to make it a two. To clinch this digit, Vince says, "Add 70." Harold reports a nine and a three.

Round 4. Where is this three? Since this is the fourth round, Vince doesn't think it is in the hundreds place. "So," he says, "add six." His guess was wrong: His opponent announces the same nine and a three.

Round 5. Apparently the three was — and still is — in the hundreds place. Vince says, "Add 600." As he had expected he gets two nines. He also gets a six.

*Round 6. Vince has the total picture now. He says, "Add a three" and gets his triple nines.**

(6) Two games make a match. The player who gets three nines with the least number of rounds wins the set.

Since Vince needed six rounds and Harold only five, Harold wins.

VARIATIONS:

(1) With younger players you can play the double nine game. With more advanced players you can try quadruple nines.

(2) Try a triple seven game with the guessing players permitted to use either addition or subtraction.

(3) Play the countdown game of reducing a three-digit mystery number to a zero through a series of subtractions.

* What was Harold's secret number?
Recall how Vince got to 999.

	x	. . . Harold's secret number
+	123	. . . Round 1
+	8	. . . Round 2
+	70	. . . Round 3
+	6	. . . Round 4
+	600	. . . Round 5
+	3	. . . Round 6
	999	Triple 9!

What is x?

The title of this page is the title of a book written by Karen Billings and David Moursund, to be published by dilithium Press. The book is aimed at junior high school students. Much of its content was classroom tested with a mixed class of seventh-ninth grade students at Roosevelt Junior High School in Eugene, Oregon in 1978. The emphasis is upon problem solving, with students exploring a variety of mathematical problem solving areas in which a computer is a useful tool. The book has also been used in several college-level courses of the "Mathematics for Elementary Teachers" variety.

The material reproduced below is from the Preface to Problem Solving with Calculators. It gives the authors' opinion on the type of calculator most suitable to the junior high school.

If your school or your students are going to purchase calculators, then we have the following recommendations.

1. Purchase a LCD (liquid crystal display) rather than a LED (light emitting diode) calculator. This virtually eliminates the problem of batteries wearing out.

2. Purchase a calculator with a simple memory system. The calculator memory chapter of this book emphasizes the four key memory system. This is a system that has M+, M-, CM, and RM keys.

3. Purchase a calculator that uses algebraic logic. Such a calculator has an = key and does not have an ENT key. (An ENT key is essential to a "Reverse Polish Notation" calculator, often used in more advanced science and engineering work.)

4. Purchase a calculator that has only a limited number of function keys beside the +, -, x, and ÷. This book makes mention of a square root key, but that is not an essential feature. No other special function keys are discussed.

5. Purchase a calculator that does not use scientific notation and which is not programmable.

To summarize, an inexpensive, 8-digit, non-programmable, algebraic logic, LCD calculator with a simple memory system is most appropriate to use with this book.

This book is designed to be used in three different modes. It can be used in a self-contained course, perhaps 9 to 12 weeks in length. Or, it can be used to supplement a longer course. If materials from this book are used once or twice per week, they will supplement a year long course. Finally, the book is suitable for self-instruction. Students can work through it at their own pace, completing as many sections as their time and interest permit.

FORMULAS

This page and the next are from chapter 4 of Problem Solving with Calculators by Billings and Moursund.

PROCEDURES

In Chapter 2 we discussed some general ideas of problem solving. The second stage is to devise a plan. Sometimes a problem is so simple one can select a plan from memory. At other times one will need to think out a sequence of steps. Some simple examples are given below.

PROBLEM SOLVING

1. UNDERSTAND THE PROBLEM
2. DEVISE A PLAN
3. CARRY OUT THE PLAN
4. LOOK BACK

Apples are four pounds for a dollar. What will one pound cost?

Procedure: Divide

$\frac{\$1.00}{4}$ = 25 cents per pound

Oranges are 29 cents per pound. How much will six pounds cost?

Procedure: Multiply

$.29 x 6 = $1.74

A jar of instant coffee is $4.79, but you have a coupon good for a fifty cent discount. What is your actual cost?

Procedure: Subtract

$4.79 - $.50 = $4.29

You purchase the pound of apples, the six pounds of oranges, and the jar of coffee. What is the total cost?

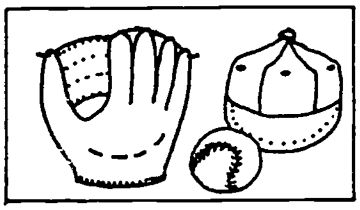
Procedure: Add

$.25 + $1.74 + $4.29 = $6.28

In this chapter we will use the words <u>procedure</u> and <u>plan</u> interchangeably. A procedure is a plan for solving a specific type of problem. One way to represent a procedure is by means of a formula.

PROCEDURES (CONT.)

In each of the following problems first write down what procedure you will use. Then write down a mental estimate of the answer. Finally solve, using a calculator.

1. 

A baseball mitt costs \$14.79, a ball costs \$3.68, and a cap costs \$2.49. What is the total cost of all three items?

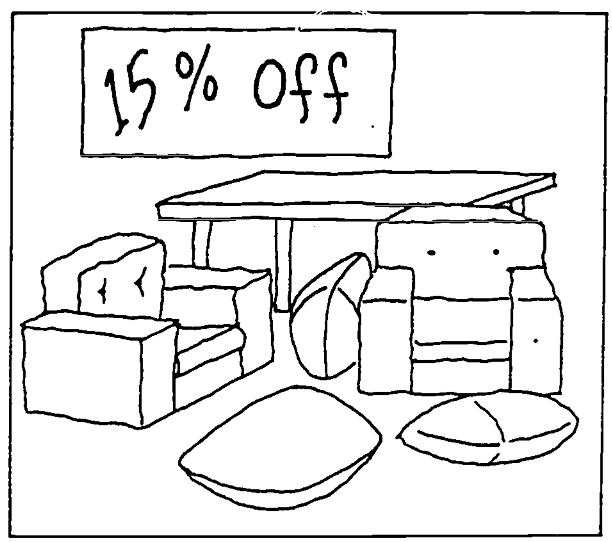
2. Pat is paid \$17.50 at the end of each week for the part-time job she has. If she saves all of it, how long will it take her to save enough money for a 10-speed bicycle costing \$134.99?

3. Bagels are \$2.08 per dozen, or 18 cents each. Orders of five dozen or more placed in advance receive a six percent discount. How much will 15 dozen bagels cost if ordered in advance?

   How much will 200 bagels cost if order in advance?

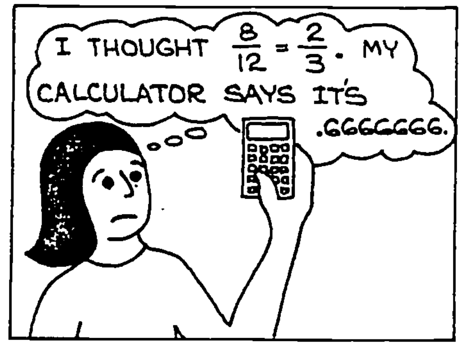
4. Corn is three cans for 79 cents and peas are four cans for 89 cents. What will be the total cost of one can of each?

5. A store is giving a 15% discount off the list price of each item. Terry buys a table listed at \$87.40, two chairs listed at \$26.90 each, and three pillows listed at \$7.99 each. How much must Terry pay?



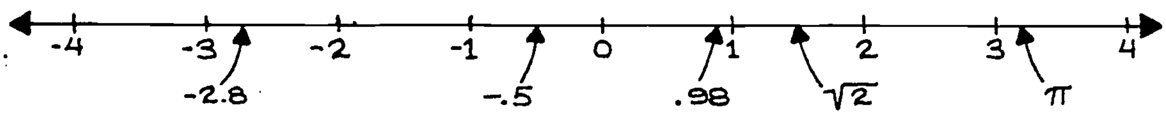
CALCULATOR ARITHMETIC

THE NUMBER LINE



By now you are aware that calculator arithmetic is not exactly the same as "real" arithmetic. The 8-digit accuracy, underflow, and overflow are examples of differences.

Every point on the real number line corresponds to a number, and vice versa.



You know that the set of real numbers is infinite. There is no largest real number, no smallest real number, and no non-zero real number that is closest to zero. There are an infinite number of points (i.e., numbers) on the number line. Between any two numbers, you can always find another one.

> **WARNING**
> *Throughout this chapter we limit our attention to a simple 8-digit calculator that does not use scientific notation. But not even all simple 8-digit calculators use the same number line and/or arithmetic.*

On a calculator number line:

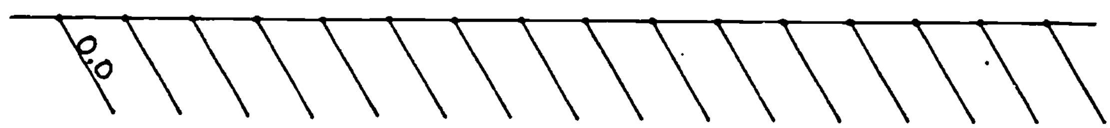
1. There is a largest (positive) number.
2. There is a smallest (negative) number.
3. There are two non-zero numbers that are closest to zero.
4. There are holes or gaps.
5. There are only a finite number of points.

((Material on this and the next three pages is from chapter 7 of Problem Solving with Calculators by Billings and Moursund. It shows that the calculator itself can be a serious topic for mathematical study.))

NUMBER LINE PROBLEMS

1. Start with 1.0 in your calculator display. Repeatedly divide it by 10 until an underflow occurs. (This happens when you unexpectly get zero as an answer.) The result immediately before the underflow is the smallest positive number your calculator can display. What is it? What is the negative number closest to zero on your calculator?

2. Find the smallest 10 positive numbers on your calculator's number line. Write them down on this diagram in order, starting with the smallest.



What is the difference between each successive pair of numbers?

3. Use your calculator to display the numbers found in 2 above. Continue to explore your calculator's number line in the range of 0 to 1.

   Complete the following sentences.

   a) In the range 0 to 1 inclusive, the number line for my calculator contains exactly ________________ points.

   b) They are equally spaced, with a difference of ______________ between successive pairs of points.

4. Use your calculator to display the negative of each of the numbers in problem 2.

   Continue to explore the numbers you can locate from -1 to 0.

   a) My calculator contains ____________ points on its number line from -1 to 0 inclusive.

   b) Each successive pair of equally spaced numbers are ____________ apart.

NUMBER LINE PROBLEMS (CONT.)

5. Use your calculator to find each of the following calculator numbers.

   a) The smallest number above 1. How much larger than 1. is it?

   b) The smallest number above 10. How much larger than 10. is it?

   c) The smallest number above 100. How much larger than 100. is it?

   d) The smallest number above 1000. How much larger than 1000 is it?

   e. The smallest number above 10000000 How much larger than 10000000 is it?

6. Complete the following sentences.

   a) In the range 1. to 10. inclusive, the number line for my calculator contains ____________ points. They are equally spaced, with a difference of _____________ between successive pairs of points.

   b) In the range 100. to 1000. inclusive, the number line for my calculator contains __________ points. They are equally spaced, with a difference of _________ between successive pairs of points.

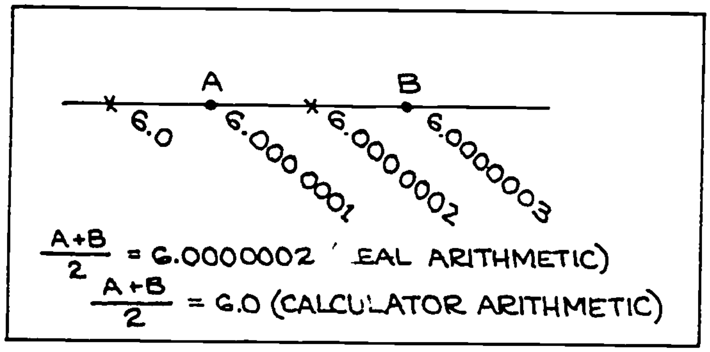
   c) In the range 100000. to 1000000. inclusive, the number line for my calculator contains __________ points. They are equally spaced, with a difference of ___________ between successive pairs of points.

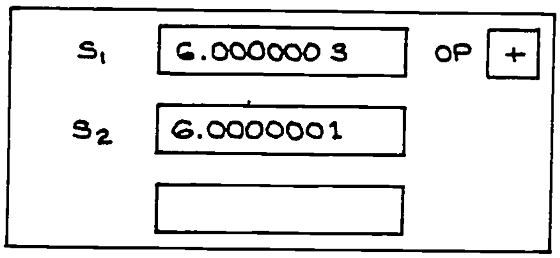
   d) In the range -10000000. to -1000000. inclusive, the number line for my calculator contains ______________ points.
   (Hint: This is the same as for 1000000. to 10000000.)
   They are equally spaced, with a difference of ___________ between successive pairs of numbers.

   e) The largest number on my calculator's number line is __________, and the negative of this is __________, (which is the smallest number). The points on this number line are not equally spaced. The smallest difference between numbers is __________, which holds for numbers between _____________ and ____________. The largest spacing is _____________, which holds for numbers between ________ and ____________, and also for numbers between _____________ and ______________.

CALCULATOR ARITHMETIC

Calculator arithmetic is peculiar! Study the example, and do it on your calculator. You know that is A and B are two different (real) numbers, then (A + B)/2 is midway between them. This may not be the case in calculator arithmetic. Indeed, the mean of two numbers may not even be between the two numbers.

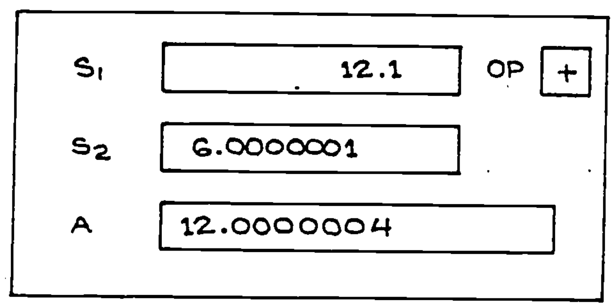




The arithmetic register, the A memory location, can contain a 16-digit number (in an 8-digit calculator). So the keying sequence

6.0000001 + 6.0000003 =

actually produces the 9-digit sum 12.0000004 in the A register. But the calculator must truncate or round this to 8 digits to store in S_1 and display it.



$$12.0000004 \xrightarrow[\text{round}]{\text{truncate or}} 12.$$

Thus the calculation:

$$(6.0000001 + 6.0000003) \div 2$$

will produce the answer 6.0 on all 8-digit calculators.

RECOMMENDATIONS REGARDING COMPUTERS IN HIGH SCHOOL EDUCATION

The Conference Board of the Mathematical Sciences is an organization whose membership consists of a number of mathematical and computer science societies. It maintains a Washington, DC office and attempts to coordinate the efforts of its societies in certain areas of mutual concern. In 1968 CBMS formed a Committee on Computer Education. It was composed of distinguished mathematics educators, several who were strongly involved in computer education. The Committee received some National Science Foundation funding to help its study. In 1972 the Committee issued a report that received widespread distribution and is frequently cited. A summary of their recommendations is quoted below.

For the most part, our recommendations are addressed both to the mathematical sciences community, urging that certain education projects be undertaken, and to the National Science Foundation, urging financial support for them. A few, however, are concerned with the way a project should be conducted.

A_1. We recommend the preparation of a junior high school course in "computer literacy" designed to provide students with enough information about the nature of a computer so that they can understand the roles which computers play in our society.

A_2. We recommend that the process of preparing the text materials for the above course be such as to provide wide and rapid dissemination of information about the availability and feasibility of the course.

B. We recommend that text materials for a number of other courses be prepared, including an introduction to computing, as a followup to the computer literacy course, some modules which integrate computing into high school mathematics courses, and other modules which utilize computers in simulating the behavior of physical or social phenomena and which enable the use of computers in the study of courses outside mathematics. (Note: While materials exist for use in mathematics and science, the module-problem nature of the recommendation reflects a quite different approach--for a more complete discussion, see sections 4 and 5 of this report.)

C. We recommend the development of special programs for high school students showing unusual aptitude and promise in computer science.

D. We recommend a major effort aimed at making vocational computer training more generally available and at the same time improving the quality of such training.

E. We recommend that the National Science Foundation provide financial support for the development of a variety of programs for the training of teachers and of teachers of teachers of high school courses involving computers.

F. We recommend the establishment of a clearinghouse for information about high school computer education.

Now, let us suppose that the above recommendations are accepted and carried out. Any school wishing to use the resulting instructional materials to institute a new computer education program, or upgrade an existing one, will find it necessary to have access to a reasonably powerful computer. We have, however, made no specific recommendations in the present report regarding relatively inexpensive computers or time-sharing arrangements suitable for high school computer education purposes. The reason for this is that our committee feels that the technology of computer hardware production is changing rapidly at the present time and will continue to change rapidly over the next few years, and that this will have major effects in lowering the cost of computer hardware and the price at which commercial time-sharing service is available.

COURSE GOALS IN COMPUTER EDUCATION, K-12

Produced by the Tri-County Goal Development Project

Over a period of years the Clackamas County, Multnomah County, and Washington County Educational Service Districts have worked together to produce detailed course goals for their K-12 curriculum. The latest of these projects deals with computers and was carried on during 1978-1979. The project, directed by Dick Ricketts, has produced approximately 300 pages of material.

At the time of preparation of this paper, the Course Goals in Computer Education materials were in their final copy-edit stage. The estimated price of the materials is about $10, from Commercial-Educational Distributing Services, P.O. Box 8723, Portland, Oregon 97208. The material given below is all quoted from the Introduction to a preliminary edition.

> This book contains goals for use in planning and evaluating elementary and secondary school curricula in computer education. Computer education includes such topics as computer literacy, computer science, computers and society, data processing, and computer programming.
>
> It is the purpose of this volume to help decide <u>what</u> should be learned, not <u>how</u>. By focusing attention exclusively on <u>what</u> should be learned, questions of instructional program and methodology can remain open. The more clearly teachers understand what learning they are trying to help students acquire, the more clearly they can perceive instructional program and methods requirements.
>
> <u>Why goals at all?</u>
>
> Goals are statements that make clear what learnings students may acquire as a result of their education. This volume and others in the Tri-County collection include goal statements that teachers and curriculum personnel can use when considering and making decisions about, optional outcomes to which they are committed.
>
> <u>What kind of goals are in this collection?</u>
>
> <u>Levels.</u> Figure 1 illustrates four possible levels of goals. Two of these are included in this collection. Program goals describe general outcomes; course goals describe more specific outcomes. These goals are suited to different types of planning. Program goals serve as guides to planning and organizing programs at district and subdistrict levels. Course goals serve as guides to planning course in schools and departments.
>
> At the system level, the board of education is responsible for approving statements enunciating the district's educational goals. Such district goals will guide selection from and adoption of the program and course goals provided here.
>
> It is important to understand that course goals require further elaboration (into instructional goals) before they are specific enough to serve as the heading of a daily lesson plan. Course goals are specific enough to leave no doubt about what the major outcomes of a course are to be, but not so detailed as to spell out precise outcomes of instruction from day to day.
>
> Examples of behavioral and performance objectives are also given in Figure 1 to show how they differ from program and course goals. While program and course goals represent clearly stated learning outcomes, the "behavioral objective" adds performance specifications for demonstrating learning, and the "performance objective" adds proficiency level specifications.

Figure I

Example of how this product directly relates to the educational planning hierarchy

PLANNING	System Goal:	Students will know and be able to apply computers in fashion appropriate to their present and future personal, career, or educational needs.	
	Program Goal:	The student knows principles, procedures, and limitations of computer systems and can use computers as a tool for inquiry, problem-solving, and recreation.	To be found in the course goal collections
	Course Goal:	The student knows the difference between system commands and program language statements.	
	Instructional Goal:	The student is able to identify LIST, RUN, SAVE, and GET as system commands.	
MEASUREMENT	Behavioral Objective:	Given the list of words LIST, RUN, SAVE, GET, GOTO, LET, READ, and INPUT mixed together, the student will identify the first four as system commands.	Not integral part of Tri County Project System of Goal-Based Planning
	Performance Objective:	Given the list of words LIST, RUN, SAVE, GET, GOTO, LET, READ, and INPUT mixed together, the student will identify the first four as system commands with 100% accuracy.	

Note: At the classroom teacher level the course goals must undergo a final translation into instructional goals and learning experiences. The Goal Development Project has chosen not to extend into this level of planning detail.

ARE YOU COMPUTER LITERATE?

A 1972 report of the Conference Board of the Mathematical Sciences recommended that computer literacy instruction be incorporated into our nation's junior high schools. Since then many other organizations and individuals have voiced a similar recommendation.

But progress on introducing computer literacy instruction into the secondary schools has been slow. Problems encountered have included a lack of adequate computer hardware and software, few teachers with appropriate knowledge, and a lack of suitable textbooks.

To help remedy the latter situation Karen Billings (a JHS teacher) and David Moursund (a professor in computer science) wrote the book Are You Computer Literate?, dilithium Press, 1979. Given below are some questions from the Computer Literacy Exam found at the end of the book. The subsequent two pages are examples of activities in the book.

Circle the best response of the four choices listed to complete each statement.

1. What is computer literacy? Is it:
   a. The ability to write computer programs?
   b. Knowing what a computer can and cannot do, how computers are used, and how they may change our lives?
   c. Knowing computer-related vocabulary, so you can read, write, and talk about computers?
   d. Understanding how to build a computer?

2. A good way to think about computers is:
   a. It is impossible for a computer to tell a lie.
   b. Computers are built and programmed by people and these people should be responsible for what computers do.
   c. Anything a human can do a computer can do better.
   d. Any problem that can be solved by a computer should be, since a computer cannot make a mistake.

3. A good definition of a computer is:
   a. An electronic automatic device than can solve problems involving words and numbers.
   b. A superspeed pocket calculator.
   c. A machine that uses binary numbers to do math problems.
   d. Any machine that can add, subtract, multiply, and divide numbers.

4. When we say a computer "understands" an instruction we mean:
   a. The computer can execute (carry out) that instruction.
   b. The computer can explain the meaning of that instruction.
   c. The computer's keyboard has a key corresponding to the instruction.
   d. It can print out a definition of the instruction.

5. Most errors blamed on computers used in business are actually due to:
   a. Hardware problems.
   b. Programming errors.
   c. Data preparation and data entry errors.
   d. None of the above.

6. A computer program for a mathematical model is called:
   a. A computer simulation.
   b. Artificial intelligence.
   c. A large scale integrated circuit.
   d. Computer graphics.

COMPUTER HAIKU

Haiku is a form of Japanese poetry. Two examples follow.

All pure in the leaves I seize pale buds in the hills Swish the leaf has blown	All black in the fog I flash red trees in the mist Look the moon has shrunk

These poems were composed by a computer. Notice that haiku is written with 17 syllables in 3 lines (5 in the first line, then 7, then 5). The Japanese poems are always about nature and give clues to the season or time of day.

Study the two poems above. What words are the same in each of them? Notice that the poems follow the patterns given below. A$ to I$ represent words to be filled in.

All __A$__ in the __B$__
I __C$__ __D$__ __E$__ in the __F$__
__G$__ the __H$__ has __I$__

A computer can write haiku by selecting words from a table provided by the computer programmer. An example of a table of suitable words is given below.

A$	B$	C$	D$	E$	F$	G$	H$	I$
Pure	Leaves	See	Round	Grass	Hills	Shoo	Flower	Dimmed
Black	Heat	Seize	Pale	Trees	Mist	Swish	Moon	Shrink
Red	Fog	Smell	Red	Buds	Dusk	Look	Leaf	Sprung
Blue	Cold	Flash	Green	Hills	Heat	Crash	Bird	Blown

The first "computer generated" haiku at the top of the page comes from the number sequence 1, 1, 2, 2, 3, 1, 2, 3, 4. That is, the computer selects the first word from the A$ column, the first word from the B$ column, the second word from the third column, and so on.

*What number sequence was used to generate the second poem?

*What poem is generated by the number sequence 4, 3, 2, 1, 2, 3, 4, 3, 2?

*Add two more words to each column of the word table. Since each column now contains six words, a die can be tossed to select a random word. Use throws of a die to generate a haiku. Does your poem make sense?

DATA ENTRY PROBLEMS

1. A good key punch operator can punch about 15,000 characters per hour. If one punched card can contain 80 characters, how many full cards can a good key punch operator punch per 8 hour day? Roughly how long would it take such a person to key punch a million character book? (That is the length of a full length novel.)

2. A particular optical character recognition machine can read one type written page in 4 seconds. Suppose that a typical page contains 40 lines of typing, and an average line is 60 characters long. Express the speed of this OCR in characters per second. How long would it take this machine to read a million characters?

3. Each year in the United States about 30 billion checks are written and cashed. The amount of each check is keyed into the check in magnetic ink, by a data entry person. Then a second person checks for errors, by keying the data on a verifier. A verifier is a machine that compares what is being keyed with what was printed on the check by the first data entry person. Suppose that one person can key in the data from 6,000 checks in one working day. Remember that this means it takes two people to actually do the data entry on 6,000 checks in one day. Estimate the number of people who make their living keying in bank check data in the United States.

HOW FAST ARE YOU

Make a set of 50 3x5 inch cards as follows. On one side of each card write a word, of about 5 or 6 letters in length. These words should come from many different parts of a dictionary. On the other side of each card write a 5 or 6 digit number. The numbers selected should all be different.

1. Shuffle the cards and deal out 25 of them. Time yourself as you arrange those 25 in alphabetical order. Shuffle the same 25 cards again, and time the numerical ordering (from lowest to highest number). Which is easier for you--alphabetical ordering or numerical ordering? Why do you think this is the case?

2. Try the process with all 50 cards. Does it take more than twice as long?

3. Now write down a detailed step by step set of directions for alphabetizing a set of cards. A third or fourth grader should be able to understand these directions. Have a friend try to follow your written directions. Revise them until they can easily be read and followed by another student. Next write down some procedure for arranging the cards in increasing order.

A computer can be programmed to alphabetize a set of words or to arrange numbers in increasing order. Computer programs can be written to follow the ideas you wrote down to order a set of cards. A modern computer can alphabetize a set of 50 words in a fraction of a second.

OPINIONS ON COMPUTER SCIENCE COURSES FOR PRECOLLEGE LEVEL TEACHERS

Oregon has a long and rich history of offering inservice and preservice teachers a good variety of computer education courses. If you or your school district is in need of a course you should begin by contacting a nearby college or university. The most extensive summer program is offered by the University of Oregon, located in Eugene. They also offer the master's degree and doctorate in computer science education. For details contact the Dept. of Computer Science, University of Oregon, Eugene, OR 97403.

The title of this page is that of a paper by David Moursund that was published in the SIGCSE BULLETIN Volume 10, Number 1 February 1978. The paper reports on a study done on the question of what courses are appropriate for precollege teachers interested in the computer education field. A questionnaire was sent to 363 people. Of the 188 respondents, nearly 73% were from the state of Oregon. The great majority of respondents were mathematics or science teachers.

All of what follows is reproduced from the February 1978 paper written by Moursund.

> There is little doubt that calculators and computers will eventually become commonplace in elementary and secondary schools. Cost is no longer a major factor with calculators, since good quality machines are available in the $6 to $9 range. The recent advent of $600 factory-built complete computer systems means that even small elementary schools can now afford substantial computing capability [1]. Thus, teacher training institutions are faced with a new and major inservice and preservice teacher training problem.
>
> This paper addresses two questions:
>
> 1. What computer science or computer science education courses should be offered by teacher training institutions?
>
> 2. What should be the nature and extent of computer-related training required for preservice elementary and secondary school teachers?
>
> To help answer these questions for the state of Oregon it was decided to develop a list of potential courses and to use a questionnaire to gather opinions about these courses. The procedure used and the results obtained are discussed in subsequent sections of this paper

Listed on the next page are some courses that could be offered by a teacher training institution. Some of the courses might be offered by a College of Education, while others might be offered by a Computer Science or Mathematics Department. Please rate each course on a scale of 0-3 as follows:

0 Should not be offered.
1 A nice extra, but not very important.
2 Important that it be offered.
3 Extremely important that it be offered.

In rating these courses, keep in mind that most teacher training institutions already offer computer programming courses, and some offer extensive programs for Computer Science majors.

Mean response		Course and brief description
1.88	1.	Calculators and Computers in Elementary Education Teaching about calculators and teaching using calculators and computers, for preservice elementary school teachers. Designed to help students become calculator and computer literate.
2.01	2.	Computers as an Aid to Instruction Uses of computers as an aid to instruction, designed for all secondary school preservice teachers. Its main emphasis is upon computer assisted instruction (CAI), computer managed instruction (CMI), and computer augmented learning (CAL).
2.38	3.	Computers in Mathematics Education The role and nature of calculators and computers in mathematics education, designed specifically for students preparing to teach secondary school mathematics.
2.27	4.	Computers in Business Education The role and nature of calculators and computers in business education, designed specifically for students preparing to teach secondary school business courses.
2.18	5.	Computers in Science Education The study of computers, including microcomputers, in the science lab, and the general role and uses of computers in science education.
2.18	6.	Basic Concepts of Computers A general liberal arts computer literacy course, not specifically oriented towards teachers. Covers the capabilities, limitations, applications, and implications of computers. Includes a brief introduction to computer programming.
1.35	7.	Calculators and Programmable Calculators A general introduction to calculators and programmable calculators, not specifically oriented towards teachers. Designed to develop understanding and skill in using the full features of more expensive calculators and/or in programmable calculators.

Part III, Section 1

Some teacher training institutions and some teacher certification programs now require computer training for perservice teachers. For each of the major topic areas listed below please check the number of quarter hours of credit that you think should be required for teacher certification of students who are currently in their freshman year of preservice teacher training. Note that the requirements you suggest might be integrated into existing courses, and/or pieces you suggest might be combined into a course carrying more credits. A quarter hour of credit corresponds to a course that has one hour of formal class meetings a week for 11 weeks. It is 2/3 of a semester hour of credit.

1. Possible requirements for certification of preservice elementary teachers.

a. Calculators--how to use them, and their use and impact in elementary school mathematics education.

(15)	(26)	(61)	(8)	(43)	(28)	(3)	(0)	(4)
0	½	1	1½	2	3	4	More	No response

quarter hours of credit

b. Computers as an aid to instruction--training and experience in computer assisted instruction, computer managed instruction, and computer augmented learning.

(9)	(24)	(53)	(7)	(35)	(32)	(14)	(8)	(6)
0	½	1	1½	2	3	4	More	No response

quarter hours of credit

c. Computers--as a topic of instruction. What should elementary school students learn about computers?

(21)	(33)	(56)	(7)	(41)	(19)	(4)	(2)	(5)
0	½	1	1½	2	3	4	More	No response

quarter hours of credit

d. General computer literacy--capabilities, limitations, applictions, and implications of computers in our society. This is not a computer programming course.

(9)	(24)	(63)	(5)	(32)	(42)	(8)	(4)	(1)
0	½	1	1½	2	3	4	More	No response

quarter hours of credit

e. Computer programming. A comprehensive introduction to writing programs to solve problems using a computer.

(54)	(24)	(33)	(4)	(19)	(27)	(13)	(12)	(2)
0	½	1	1½	2	3	4	More	No response

quarter hours of credit

Table 3.1 (Previous page) Possible requirements for elementary teachers. The numbers in parentheses are the number of people giving each response.

Part III, Section 2

2. Possible requirements for preservice secondary school teachers.

a. Computers as an aid to instruction--training and experience in computer assisted instruction, computer managed instruction, and computer augmented learning.

(8)	(18)	(43)	(12)	(33)	(42)	(14)	(13)	(5)
0	½	1	1½	2	3	4	More	No response

--------------------quarter hours of credit--------------------

b. General computer literacy--capabilities, limitations, applictions, and implications of computers in our society. This is not a computer programming course.

(5)	(13)	(51)	(10)	(35)	(50)	(9)	(9)	(6)
0	½	1	1½	2	3	4	More	No response

--------------------quarter hours of credit--------------------

c. Calculators and programmable calculators-- how to use them, and applications to education.

(23)	(24)	(54)	(8)	(36)	(28)	(4)	(4)	(8)
0	½	1	1½	2	3	4	More	No response

--------------------quarter hours of credit--------------------

d. Computer programming for math and science oriented students--a course to be required of preservice secondary school science and mathematics teachers. (Note change in scale labels).

(5)	(11)	(17)	(54)	(29)	(28)	(22)	(18)	(4)
0	1	2	3	4	6	8	More	No response

--------------------quarter hours of credit--------------------

e. Computer programming for business oriented students--a course to be required of preservice secondary school business teachers. (Note change in scale labels).

(8)	(14)	(27)	(49)	(36)	(24)	(11)	(12)	(7)
0	1	2	3	4	6	8	More	No response

--------------------quarter hours of credit--------------------

f. Computer programming for social science oriented students--a course to be required of preservice secondary school social science teachers. (Note change in scale labels).

(22)	(32)	(31)	(54)	(26)	(11)	(4)	(2)	(6)
0	1	2	3	4	6	8	More	No response

--------------------quarter hours of credit--------------------

Table 3.2 Possible requirements for secondary teachers. The numbers in parentheses are the number of people giving each response.

Four states (Ohio, Minnesota, Texas, Wisconsin) now provide for the certification of secondary school teachers of Computer Science. The question has been raised as to whether this should be done in Oregon.

Do you think Oregon should create a secondary school teaching norm in Computer Science (that is, establish certification standards for this area)?

97 = 51.6% Yes
69 = 36.7% No
22 = 11.7% No response

Table 4 Certification of teachers.

OVERVIEW OF COURSEWARE

The development and dissemination of courseware (well documented programs, teacher guides, student handouts and/or texts, etc.) is a major block on the road to integration of computers into the curriculum. Development seems to require at least as much (probably significantly more) effort and time as does a text covering the same material. Time and effort coupled with hardware costs and scarcity of knowledgeable people in the field would appear to make the widespread use of computers in education impossible in the near future.

The long term outlook is not all that dim, however. Several large federally funded projects have survived the test of time, and many smaller and less publicized efforts are occurring.

LARGE

Probably the best know computer assisted instruction projects are PLATO, TICCIT, and the work of Pat Suppes.

"A Personal Evaluation of the PLATO System" was published in the April 1978 issue of the SIGCUE* Bulletin** and reprinted in the Oregon Computing Teacher, vol. 6, #1. The conclusion to that evaluation is quoted below. Plato was developed at the University of Illinois with funding from NSF and the State of Illinois.

POSITION PAPER: PLATO Evaluation

Conclusion - Positive Plus Negative (the Vector Sum)

PLATO management at both CDC and the University of Illinois has been making a great effort to market the PLATO system to educational groups such as colleges, universities, public schools, community colleges and training centers within industry. As a result some teachers are aboard the PLATO bandwagon only because funds are available and because PLATO represents "the latest thing" in education. This is unfortunate. PLATO lessons are just programs written by some programmers -- any lesson is only as good as the author who wrote it. The good PLATO lessons are very, very good; the bad lessons are worse than useless -- they block rather than shed illumination. The percentage of wheat to chaff for PLATO lessons appears to be the same as it is for textbooks -- on the order of 5 to 10%. Despite its many shortcomings however, I believe that PLATO is a "good thing" and I base that judgement primarily on the almost universally enthusiastic student reaction to the system. The faults that I listed previously can, with time and energy, be overcome; but no system, no matter how well designed can succeed unless it attracts a suitable sized, devoted user population. PLATO seems to be comfortably over that particular hurdle -- thanks to the efforts of people like Alpert and Bitzer at the University of Illinois.

Since the development of PLATO has been picked up by CDC and is being guided by a group of what I consider to be highly competent, dedicated and enlightened people, I have high hopes for its success if computer costs continue to decrease and something can be done about the increasing costs of telecommunications. Like any other man-made tool, PLATO technology can be used or mis-used with equal ease. PLATO's potential is deep and broad and, if intelligently and humanly used, can really help people educate themselves.

*Special Interest Group on Computer Uses in Education

**Editor's note: This article first appeared in the April 1978 issue of the SIGCUE Bulletin, which is a publication of the Association for Computing Machinery. Annual dues for the SIGCUE publication are $5. for ACM members and $12.50 for non-members. The address is PO BOX 12105, Church Street Station, New York, NY 10249.

The TICCIT system was developed at Brigham Young University in conjunction with The Mitre Corporation. "TICCIT Update" by Curt Torgerson appears in vol. 4, #3 of the Oregon Computing Teacher (OCT). It is not as lengthy or as detailed as the PLATO evaluation but does express the same guarded optimism. TICCIT makes use of modified color TV sets as terminals, and runs off of microcomputers. Thus it is considerably less expensive than PLATO.

Both PLATO and TICCIT have had exhaustive evaluations, both of which were performed by Educational Testing Service (ETS).* For a somewhat less optimistic outlook than those above see "Can Computer Aided Instruction Profit from the Developments in Artificial Intelligence", by Doris Lidtke, in OCT vol 6, #3. This article also has a good list of references for those interested.

Patrick Suppes is well known for developing an extensive amount of CAI material for use at the grade school level. He developed drill and practice materials during the 1960's for use in mathematics and language arts. These materials are still widely used. Some insight into the nature of the materials is provided by examining how the math materials were developed. About a dozen elementary school math textbook series were analyzed, and a count was done on the number of each type of problem that appeared. Then the math drill and practice materials were developed to provide a typical student with 10 minutes per day of drill, throughout grades 1-6. This drill corresponds to an "average" of the types of problems, and their frequency, occurring in the texts that were analyzed.

Small

With the advent of smaller less expensive computers, different types of development began happening. More single lessions or programs are being written. Some of these are well prepared and ready for teacher use, while others are poorly documented with little or no additional courseware.

The Huntington II modules are well done and provide student and teacher materials to be used with the programs. The programs are widely distributed (OTIS and most universities have them) and the teacher materials are available from Digitial Equipment Corporation.

Descriptions and uses of other locally developed programs appear in various journals (see bibliography) but generally are not well publicized.

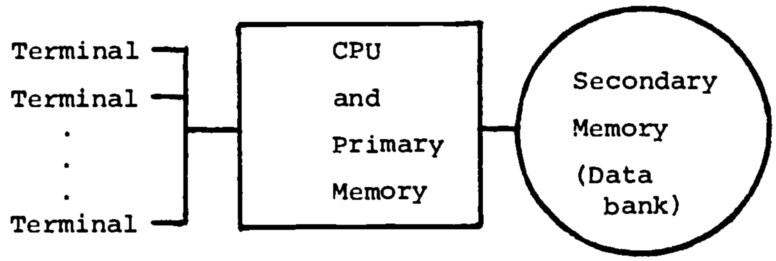
Microcomputers are becoming more available and common. Many programs (but little other materials) are and will be available. The major problem in this area is one of evaluation and selection. Centers to provide this service will eventually exist. Judy Edwards (Northwest Regional Education Lab, 710 S.W. 2nd) in Portland has received large federal grant funding for just such a service.

* Murphy, R.T. and Apple, L.R. Evaluation of the PLATO IV Computer based Education System in the Community College. Educational Testing Service, Princeton, N.J., 1977.

* Alderman, Donald L. Evaluation of the TICCIT Computer Assisted Instructional System in the Community College. Educational Testing Service, Princeton, N.J., 1978.

CAREER INFORMATION SYSTEM

A very important and rapidly growing application of computers is for information storage and retrieval. The typical setup makes use of a medium scale or larger timeshared computer system. Users of the system are connected to it via telephone lines to keyboard terminals.



Many people can make simultaneous use of such an information retrieval system. The data bank can be quite large - frequently it will consist of many millions of characters of information. This can be updated periodically or in "real time". The latter would be common for airline or motel reservation systems, and for law enforcement information systems.

The most widely used information retrieval system in Oregon's schools is the computerized version of the Career Information System. (It also comes in a needle-sort version, for use by people who don't have access to a computer.) About a hundred thousand people in Oregon make use of the computerized CIS each year. It is common to find JHS and SHS Career Education courses built around use of CIS. Students interact with a computer to explore possible careers and educational opportunities. Some material from a CIS User's Handbook is reproduced here and on the next page.

Oregon CIS
247 Hendricks Hall
University of Oregon
Eugene, OR 97403
(503) 686-3872

Start

We all need information to make decisions. The Career Information System can help you get current information to use in your own career planning.

There are several places you can start:

Are you undecided about what occupations to explore?

If so, you can state your likes and dislikes and get lists of job titles to explore. Turn to QUEST on page 1.

Do you have some future occupations in mind?

Some of the most current information about occupations is available for you to use. It includes working conditions, hiring requirements, job outlook in the area where you want to live, ways to prepare for employment, and other career information. See OCCUPATIONS, page 7.

Do you have a field of study in mind?

You can find out about courses, teaching methods, and degrees. You can get a list of schools and learn what careers those programs of study can lead to. See PROGRAMS OF STUDY AND TRAINING, page 15.

Are you considering certain schools or colleges?

Do you have questions about the kind of programs they offer, or their sizes, costs, admission requirements, housing, or services? See SCHOOLS, page 20.

Are you looking for a job right now?

The system does not have information about current job openings, so you will need to get help elsewhere. A counselor or work experience coordinator might be able to help, or you could check with the Employment Division office or other sources of current job openings.

For QUEST, turn to page 1.
For OCCUPATIONS, turn to page 7.
For PROGRAMS OF STUDY AND TRAINING, turn to page 15.
For SCHOOLS, turn to page 20.
For HOW TO USE THE COMPUTER TERMINAL, turn to page 27.

O C C E

The Oregon Council for Computer Education (OCCE) is comprised of educators who wish to promote the instructional use of computers. The goals of the organization are:

1. To participate in the state-wide coordination of activities relating to the instructional use of computers in Oregon.
2. To promote equal opportunity for all students within Oregon to enjoy the potential benefits and enrichment of instruction that is afforded by the computer.
3. To provide curriculum guidelines and standards for the instructional uses of computers.
4. To recommend programs and standards for the training of those involved in computer-related instruction.
5. To encourage the establishment of effective mechanisms for the sharing and dissemination of information concerning computer-related instruction.
6. To promote sound developmental directions for computer related education through program evaluation.

OCCE should be considered a prime resource for the state of Oregon in the area of computers in education. Several articles from its "semi-periodical", the "Oregon Computing Teacher" (OCT) have been selected and grouped here together to indicate types of information available there. OCCE also publishes "Special Reports" from time to time and several are also presented here.

At the time of this writing OCCE is undergoing a change. As of March 31, 1979 OCCE will be "going national." A committee is being formed to suggest revisions to the constitution so other state and regional organizations may be included. It is expected that OCCE will become a National Council for Computers in Education. The Oregon Computing Teacher will become The Computing Teacher and is expected to be published on a more regular basis (six times per year).

Those wishing to join this professional organization or to purchase back issues should contact Howard Bailey. Howard's address is:

Howard Bailey
Computing Center
Eastern Oregon State College
LaGrande, Oregon 97850

Please include name, home and school addresses, and phone number along with dues when joining the organization. Dues for 1979-80 are $8.00.

OCCUPATIONS

These 240 occupational categories cover about 95% of the employment in the state and the major kinds of work found elsewhere in the country.

Find the occupations you want to know about. Note the occupation codes, then see "Using the computer terminal," page 27.

1614 Accountants and Auditors
98662 Actors and Actresses
1100 Administrative Occupations
1136 Administrators, Education
1134 Administrators, Health Service
1138 Administrators, Public
Advertising-Related Occs., see:
- 7422 Business Services Salespeople (includes Advertising Salespeople)
- 4724 Commercial Artists and Designers
- 4734 Photographers
- 1195 Public Relations Workers
- 2176 Writers and Editors

23541 Aerospace Engineers
4100 Agriculture and Forestry Occs.
8428 Aides, Social Service
8488 Aides, Recreation
1422 Aides, Teacher
3116 Aircraft Mechanics
Airline Careers, see:
- 3116 Aircraft Mechanics
- 6126 Air Traffic Controllers
- 7856 Flight Attendants
- 6188 Pilots and Flight Engineers
- 1424 Travel Agents

Airline Pilots (see 6188 Pilots and Flight Engineers)
6126 Air Traffic Controllers
4174 Animal Caretakers
9824 Announcers, Radio and Television
Anthropologists (see 2164 Social Scientists)
3169 Appliance Repairers
1634 Appraisers and Underwriters
2316 Architects
Art-Related Occupations, see:
- 4442 Clothes Designers and Patternmakers
- 4724 Commercial Artists and Designers
- 8456 Elementary and Secondary Teachers
- 5982 Handcrafters
- 2366 Interior Designers and Decorators
- 4734 Photographers
- 8454 University and College Teachers

4724 Artists and Designers, Commercial
9866 Artists, Performing
5686 Assemblers, Electronics
5966 Assemblers, Production
9868 Athletes, Professional
Attorneys (see 8432 Lawyers)
8128 Audiologists, Speech Pathologists and
1614 Auditors, Accountants and
Automobile Body Repairers (see 5486 Body & Fender Repairers)
3112 Automobile Mechanics
7418 Automobile Salespeople

Baby Sitters (see 3456 Domestic Service Workers)
4324 Bakers
1644 Bank Tellers
8184 Barbers
7852 Bartenders
Beauticians (see 8186 Cosmetologists)
26112 Biologists
5488 Blacksmith and Forge Shop Workers
5486 Body and Fender Repairers
5483 Boiler Makers, Structural Metal and
5944 Boiler Operators
47668 Bookbinders and Bindery Workers
1616 Bookkeepers
1600 Bookkeeping, Accounting, Computer Occupations
Botanists (see 2611 Life Scientists)
Box Boys and Box Girls (see 7134 Grocery Baggers)
4264 Bricklayers

Schools

Over 200 schools in Oregon offer educational programs to the public. They include public and private colleges and universities, community colleges, and private vocational schools of many types. All are listed below. (Not listed are employers' training programs for their own employees, correspondence schools, or schools in other states, except those in Vancouver, Wash.).

You can use the computer to compare as many as three schools at a time.

1. Find the schools you want information about. You will use the school codes to get information from the computer.
2. Then select the SCHOOL TOPICS on page 24.

71801 A'Arts Eugene College of Beauty
71203 Academy of Hair Design
49779 Advertising Art School
49139 Albany Airways, Inc.
49295 Albany General Hospital
71239 Albany College of Beauty
44237 Allied School of Real Estate
71819 Angelicque's College of Beauty
71104 Astoria Beauty College
49102 Astoria Flight Service
49203 Aurora Aviation

49723 Bassist Institute
71705 Beau Monde College of Beauty
Beauty Schools (Prog 168 lists Beauty Schools)
44716 Beaverton Business College
44706 Becker CPA Review Course, Ltd.
49414 Bend Air
Bible Schools (see Religious Schools)
49415 Blue Mountain Aviation
22411 Blue Mountain Community College
44733 Bryman School (Portland Paramedical Center)
44703 Bucher Institute of Real Estate
Business Schools (Prog 158 lists Business Schools)

49787 Career Trends
99708 Caryl Edeline Finishing & Modeling School
49104 Caveman Aviation, Inc.
22413 Central Oregon Community College
44711 Century 21 Real Estate Academy
44707 Chase Business College
22207 Chemeketa Community College
44238 Chuck Clow Real Estate School
99209 Cinderella School of Self-Improvement & Models Agency
22708 Clackamas Community College
22704 Clark College (Vancouver, WA)
22105 Clatsop Community College
21223 Colegio Cesar Chavez
71706 College of Beauty
Colleges and Universities (4-year, public and private), see:
- 21223 Colegio Cesar Chavez
- 21729 Columbia Christian College
- 21704 Conquerors Bible College
- 21414 Eastern Oregon State College
- 21826 Eugene Bible College
- 21209 George Fox College
- 21709 Lewis & Clark College
- 21207 Linfield College
- 21705 Marylhurst Education Center
- 21221 Mt. Angel Seminary
- 21719 Museum Art School
- 21829 Northwest Christian College
- 21215 Oregon College of Education
- 21701 Oregon Graduate Center
- 21418 Oregon Institute of Technology
- 21219 Oregon State University
- 21711 Pacific University
- 21718 Portland State University
- 21706 Reed College
- 21113 Southern Oregon State College
- 21812 University of Oregon
- 21715 University of Oregon Health Sciences Center, School of Dentistry

These are only part of the Occupations and Schools covered in CIS.

OCT ARTICLES

ACTIVITIES

Calculus (1) *

John Shirey uses a program called CVAREA (available on OTIS) to illustrate the accuracy of various methods of determining area under a curve. Output from the program is used as a springboard to discuss the different methods in more detail.

Calculators (2)

Jean Rogers gives a step by step procedure for introducing calculators for the first time to elementary students. Essentially everything but the calculators and the students is provided in this article.

"English
Usage
Exercises" (3)

John G. Allee (et. al.) have developed two volumes of CAI sessions that "primarily explore verb-pronoun relationships that often reflect written usage problems...". Outputs from several of the programs are given as is a listing of one of the 198 programs.

Biology (4)

This article presents a use of the computer at the college freshman level but may well have some merit for high school classes. Grant Thorsett discusses several programs used in biology lab sessions. The primary goals of these programs are to introduce the topic of genetics and to simulate results of gene pool manipulation.

General
Usage (5)

Karen Billings gives an overview of the uses made of a computer terminal (hooked to OTIS) at Roosevelt Junior High School in Eugene. Specific programs used (other than CIS) are not given. A fairly detailed outline of a 9-week computer literacy course is also presented.

Then What? (6)

The following two pages present one method of keeping students motivated and at the same time showing them the "real world".

* A bibliography of the articles referred to here is included at the end of the Articles Section, page 49.

With or
Without a
Computer (7)

The following article summarizes one of the sessions of a joint annual conference held by OCCE and the Oregon Association for Educational Data Systems (OAEDS). The article illustrates some activities that can be used whether or not a computer is available. A book by Jan Rice, My Friend-The Computer served as the basis for this conference session.

Session: Using My Friend-The Computer With Upper Elementary and Junior High Students (Sara Jane Bates, Nancy McClellan, Bob Tower)

Summary by Marjorie Anthony

Nancy McClellan gave a brief explanation of how she used this book by Jean Rice as her main resource with 4th and 5th graders to increase their computer literacy level. Having no access to a computer facility, she depended primarily on this book and two films, The Computer, for grades 2-6 and Computers, for grades 4-9, to impart some of the basic concepts.

Some points of emphasis included in the course were: the importance of stressing to young children that computers do not think--they are programmed by people to do the things they can do, the parts of the computer and the function of each part, simple computer vocabulary, computer hardware and software, and flowcharting.

Sara Jane Bates, a junior high school mathematics teacher, worked with students who had no previous experience with computers. Her class consisted of about 22 ninth graders and met daily in 45-minute class sessions for 3 weeks.

Since she would have access to a computer facility, Ms. Bates' plans for the class included hands-on activities with a terminal. Goals for the class were (1) to acquaint students with the computer, (2) help students become computer literate, and (3) provide experience with the computer.

The book My Friend-The Computer and accompanying teacher's guide and activity book were used as the primary resource. The class soon discovered that this material was written for elementary school students. It was necessary to explain away this fact by agreeing that since they were elementary in their approach to computers due to having no previous experience, it was reasonable to use their materials.

Booklets for each student were made from the spirit masters in the teacher's guide and activity book. In addition to the booklet of worksheets, other activities included reports, interviews with people who use computers in their work, a speaker with display equipment, using the computer terminal, and projects. An early lesson in the sequence of lessons involved logging on the computer, typing a short program of a "print" exercise (for example, 10 Print "anything you want"), running it, and logging off the computer. Other assignments included work with punch cards, making flow charts, writing a program to solve a mathmatics problem, writing to computer companies for information, preparing various reports, and completing 2 of 3 projects which were (1) make up a problem and write a program for it (2) prepare a flowchart (3) prepare a scrapbook.

(continued on next page)

(continued from previous page)

Because of a noisy terminal in the classroom, special plans to work around this difficulty were necessary. Extra time was spent after school hours to accommodate the students.

In an after-course evaluation students indicated that they thought the course was very worthwhile. They especially enjoyed the work at the terminal. Some students were enthusiastic to the point of continuing their work after the course was over. As an outgrowth of this, an elective course on computers will be added to the curriculum.

Bob Tower, a high school English teacher, explained how he is working with a class of 21 seventh graders, an aide, and access to a computer terminal in the administration building of his school district. His plans are much the same as those of Ms. Bates. They included having the students write to different computer companies asking for information and materials. All but one of the companies responded. Hewlett-Packard sent a series of booklets which the company has prepared for classroom use.

Plans for the near future include a field trip to the university computer center. Mr. Tower commented that instructors at the center had been very helpful with suggestions and cooperative about the prospective field trip.

Some results of having established this include: the enthusiastic involvement of the students who have involved their mathematics teachers, students using the computer after class to write their own programs for solving mathematics problems, and plans to install a computer terminal at the high school.

Questions and Answers

In response to questions from the group, the three teachers indicated that (1) feedback from parents was generally supportive, (2) three weeks was long enough for this first experience but a longer period of time would be desirable for subsequent classes, (3) much supplementary materials, especially on programming and using the terminals, would be needed for secondary students to be adequately challenged during an entire term (4) prioritizing, rearranging schedules, and using the new courses to help teach basic skills are ways to keep new courses from replacing the "basic skills" courses that many people fear are being displaced.

PHILOSOPHY

Literacy (8)

The following quote from an article by Andrew R. Molnar of the National Science Foundation* gives good insight into the area of computer literacy. (The abstract of the article is quoted.)

> The information explosion in science and the shift in our economy from the production of industrial goods to a greater emphasis on science and knowledge-based industries has created a discontinuity in the nature of jobs and our educational needs. Ironically, widespread dissatisfaction with our schools has led to a nationwide, back-to-basics movement. Computers which have become indispensable to the operation of science, business, and government are not a major part of American education. While many schools have introduced computers into their curriculum, these local efforts only partially satisfy the country's needs at costs which are prohibitive and unnecessary when viewed nationally. In an information society, a computer literate populace is as important as energy is to an industrial society. Other nations have begun the task of restructuring their systems to include computers and unless we begin soon, the next crisis in American education will be the computer literacy crisis.

* The views expressed are those of the author and do not necessarily represent the views of the National Science Foundation. This paper is based upon comments made at the February 16, 1978 meeting of Society for Applied Learning technology in Orlando, Florida.

Privacy Issue (9)

Reid Elliott, a high school student in Advanced Computer Programming, submitted this paper to his teacher as part of the course requirements. Reid does a very good job of pointing out the possible failures in our current methods of overseeing the use of data banks. An all too possible scenario of events is presented and Reid gives us his ideas on how to avoid such events actually taking place.

This article is a fine example of an issue computer educators should be concerned with. It also shows one method of introducing students to the problem.

Teacher
Education (10)

Dave Moursund presents his ideas on elementary teacher education and certification. Quoted below is his introduction to the article. Selected sentences from supporting arguments are also quoted.

> The time has come to require a substantial study of calculators and computers by all preservice elementary school teachers. This document presents arguments to support that position and a discussion of the major content that should be included in teacher training program. Two approaches to implementation are also discussed.
>
> An elementary teacher is a college graduate, and should be at least well educated as the average college graduate.
>
> There are changes that could/should occur in the elementary school mathematics curriculum merely because calculators exist and are readily available in the real-world.
>
> A calculator is merely a limited-purpose computer. It can be an inexpensive and effective aid to instruction.
>
> Since those machines are a common part of the real world it follows that students should learn about their capabilities, limitations, applications and implications.
>
> The computer could/should have a significant impact upon the elementary school curriculum merely because it is a readily available tool in the real world.
>
> The computer can be viewed as an interactive educational medium, incorporating a combination of ideas from printed material and TV.
>
> It is not yet clear what elementary school students should learn about the capabilities, limitations, applications and implications of computers. We do know they are capable of learning a great deal -- either of correct information or of incorrect information.

But Be
Careful (11)

David Dempster advises against using calculators to teach "basic computational skills" and discusses some precautions for implementing the use of calculators. Most of the precautions relate to the basic skills area or to including school administrators and the community when deciding if, how and when to use calculators in the classroom.

A Computer Science Course (12)

Mike Dunlap presents a different concept of a high school computer science course in that programming and theory are de-emphasized. Detailed goals and topics of study are presented. Quoted below is part of his overview of the course.

> This course is designed to provide the student with a basic introduction to computer science. It considers the history of computers, a simplified look at computer programming, problem solving, problem logic with flowcharting, concepts of computer systems and architecture, survey of available computer languages, simple computer mathematics, elementary computer electronics, applications of the computer, the computer industry, and the future of computers.

History (13)

Edwin Landauer presents a short history of computing mechanisms from the abacus to the modern computer. Though brief, this article is a good survey of computer history and can serve as a good base of study for a unit in a computer literacy course. The introduction is quoted below.

Most of the major changes in computers (devices that compute) have been made in the last twenty-five years, but computing devices of some kind can be traced back as far as five thousand years. This evolution of computers from the most primitive counting devices to the large modern computers can be separated into four groups or classes of computers.

(1) Counting machines, made of beads or gears, are used for addition, subtraction, multiplication and division.

(2) First generation computers are computers whose circuitry depended on vacuum tubes.

(3) Second generation computers replaced the vacuum tube with transistors, for increased speed and reliability.

(4) Third generation computers used large scale integrated circuitry and miniaturization of components to replace transistors; this reduced costs, and further increased speed and reliability.

By 1950, scientists in nearly every civilized country realized the importance and need of computers. It would be impossible to list all of the important events that took place from 1950 to the present in this article. It is for this reason that my goal in this article is to look at only the first two of the above mentioned groups in any detail. The last two groups will be mentioned briefly, listing only some of the major topics.

AI & CAI (14)

Artificial Intelligence in the Classroom - Part I

William S. Bregar
Computer Science Department
Oregon State University

This article is the first in a two part series which will try to provide a basis for understanding Artificial Intelligence and its application to computer-assisted instruction. In this part we will focus on some aspects of Artificial Intelligence namely, knowledge representation and natural language understanding. In the second installment, we'll look at some approaches to problem solving and specific implementations in CAI systems.

Basic Math
and PLATO (15)

This article by Edward Wright serves 3 purposes.

A brief overview of the Heimer Mathematics Program is given. The Heimer program is based on 4 "conditions of adequacy" for a "personalized system of instruction" and further on 12 "instructional propositions". Wright discusses how the courseware was created and presents the model used in implementing the program.

The results of an experiment where this program was implemented are presented.

Since the program was implemented on a Plato system, some comments about PLATO are interspersed throughout. The following evaluation of PLATO is also given.

> I was very impressed with the capabilities of the CDC PLATO System. It allows the designer main options in the presentation of the material. From the time I began with my first on-line experience with PLATO until I had prepared the courseware for the Multiplication Algorithm, I had spent five months working with PLATO, -- roughly 600 hours of on-line time.
>
> Most of us who will use PLATO will not be designing material. Rather, we will be managing and adopting material created by other authors for use within our classrooms. To use material that has been created and adapt it to fit existing classroom procedure will require the equivalent time that is spent adopting a new textbook. PLATO is an alternative form of material presentation. It is, I believe, a forerunner of the future textbook.

For the
Beginner (16)

A NOVICE'S GUIDE TO COMPUTERS IN SECONDARY SCHOOLS

This paper is intended for the teacher or school administrator with little or no previous computer experience. It provides an overview of some eucational uses of computers. It then discusses key ideas of hardware and software. Finally, it focuses upon the issue of microcomputers versus time-shared terminals for use at the author's school.

- -

Imagine a new modern junior high school that has been given a government grant specifically for the use of computers in instruction and school related services. Imagine also that the grant has no financial limitations and no stipulations as to how computers can be used within the school setting. What kinds of things involving computers would one be likely to see happening in this lucky junior high?

Selection of
a System (17)

This article by Tony Jongejan and Jerry Johnson is a report on a conference held in May of 1978, "Computer Equipment for Mathematics Education: Which Way to Go?". The conference was attended by math educators and computer vendors.

A set of minimum requirements was arrived at by the educators and then a more specific set of questions was presented to the vendors. From the vendors responses a comparison chart of different systems was prepared.

The requirements, questions to vendors, responses and a comparison chart are all presented in the article. The following note of caution is given. "The authors suggest that this be used only as a guide and that more accurate information be obtained from your local dealer."

Bibliography of OCT Articles Used

1. Shirey, John "Using the Computer at Churchill High School", vol. 5 #3, June 1978.
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3. Allee, John G., et al "An Elementary School Language Arts CAI Series", vol. 6 #3, February 1979.
4. Thorsett, Grant O. "Application of the Computer in an Introductory Biology Laboratory", vol. 4 #3, May 1977.
5. Billings, Karen "Computer Use at Roosevelt Junior High School", vol. 3 #3, April 1976.
6. Garrett, Keith "You Get Students Turned On and Then What?", vol. 2 #2, June 1975.
7. Bates, McClellan, Tower "Using <u>My Friend-The-Computer</u> with Upper Elementary and Junior High Students", Session Summary by Marjorie Anthony, vol. 5 #2, April 1978.
8. Molnar, Andrew R. "The Next Great Crisis in American Education: Computer Literacy", vol. 6 #1, September 1978.
9. Elliott, Reid "Computers and Privacy: What [illegible] Done?", vol. 6 #2, December 1978.
10. Moursund, David "Calculator and Computer Education for Elementary School Teacher Certification", vol. 5 #1, October 1977.
11. Dempster, David "When NOT to Use Calculators", vol. 3 #3, April 1976.
12. Dunlap, Mike "Computer Science in High School 'A Course Outline'", vol. 1 #1, May 1974.
13. Landauer, Edwin G. "Computer History", vol. 4 #1, October 1976.
14. Bregar, William S. "Artificial Intelligence in the Classroom - Part I", vol. 4 #3, May 1977.
15. Wright, Edward B. "Use of PLATO in Teaching Basic Mathematics", vol. 5 #1, October 1977.
16. Jensen, Kenneth "A Novice's Guide to Computers in Secondary Schools", vol. 6 #1, September 1978.
17. Jongejan, Tony and Johnson, Jerry "Selection of a Computer System: A Dilemma for Educators", vol. 6 #2, December 1978.

OCCE SPECIAL REPORTS

Five of the "special reports" that have been published by OCCE have been included here. The special reports are published whenever the need arises or suitable material becomes available. Only the introductions to the reports are reprinted here.

COMPUTERS AND COMPUTER LITERACY IN THE ALGEBRA I AND THE TRIGONOMETRY CLASSROOM

"Computer literacy" refers to the non-technical and low-technical aspects of the capabilities and limitations of computers, and of the social, vocational and educational implications of computers. There is general agreement among people knowledgeable in computer science that all students should acquire a reasonable level of computer literacy. This could be divided into two parts. First, there is the very general computer literacy that would be taught in a computer literacy course, or included in social studies, math, and science courses required of all students before high school graduation. One can think of this as providing the minimal skills and knowledge needed to cope with the computer aspects of life in our current society.

A second aspect of computer literacy can be associated with the various subject matter courses a student takes in high school. Thus, a student who studies higher level math courses should develop a math-oriented computer literacy compatible with his increased knowledge in mathematics; similar statements can be made about science courses, social science courses, etc. It is to this latter aspect of computer literacy that this document is directed.

The first section, "Integrating Computer Literacy with Existing Classes," is a paper prepared by nine teachers who were participants in the course, <u>Teaching Computer Literacy</u>, taught by David Moursund at the University of Oregon during Summer 1974. After addressing the general topic of teaching computer literacy through existing courses, it focuses upon the specific course, Algebra I, and provides a number of specific examples of things that could be done in that course.

The second section, "Guide to Computer Augmented Trigonometry," was written by two teachers who were participants in the course, <u>Computer Curriculum Materials</u>, taught by Mike Dunlap at the University of Oregon during Summer 1974. It contains a number of suggestions on using computers in a trigonometry course. The main emphasis in this case is the enhancement of learning of the traditional course content. However, a student in such a course will acquire an increased knowledge of the use of computers in mathematics.

RECOMMENDATIONS FOR IMPLEMENTING COMPUTER LITERACY IN OREGON SECONDARY SCHOOLS

This study was undertaken for the Oregon Commission on Computers in Education (1) to establish that the study of computer technology and its impact on society is consistent with the competency-based educational program in Oregon and (2) to outline the resources and training needed to implement a computer literacy program and to list some of the resources available in Oregon to assist with the task.

Several years ago, the Oregon Board of Education adopted requirements that students graduating from Oregon High Schools be competent in areas of personal development, social responsibility, and career development. That is, students must demonstrate the achievement of local district and state approved "survival level skills" in these three areas. A primary question addressed in this document is: which objectives might a local district wish to adopt in order to help its graduates survive a computerized society?

The Commission on Computers in Education has been formed to establish standards for computer use and to assist LEAs in planning, implementing, and evaluating computer instruction. One goal of the Commission is to establish guidelines for computer literacy. The document which guides the Commission defines computer literacy as:

> . . . awareness, attitudes, and knowledge necessary to understand the effects of the computer on society. It is essential that everyone be cognizant of the capabilities and limitations of the computer and be attuned to the social, vocational and governmental implications of the increasingly widespread utilization of computers.[1]

The Commission has requested that an effort be initiated to operationalize this definition in Oregon School Districts. The process of bringing about a computer literacy program will involve careful definition of program objectives, agreement upon program needs by interested parties, such as parents, teachers, etc., assessment of learner competencies, dissemination of these through a curriculum guide and definition of teacher training programs.

This paper will first address the reasons for undertaking a computer literacy program and provide a brief synopsis of the status of computer education programs in Oregon. It will then outline a procedure for defining and assessing computer literacy and make recommendations to the Commission for follow-up activities in the area of curriculum development and teacher training.

Appended to the paper are: (1) a list of course competencies which can be inserted into existing State Department graduation requirement publications to modify their recommendations, (2) a rating scale used in a study to define computer literacy, (3) sample teacher training programs, (4) reprints of documents on careers in the computer field, and (5) a newspaper article on how an existing occupation may be changed by computer technology.

---

[1] Statewide Plan for Educational Computer Services in Oregon, available from Department of Education, 942 Lancaster Drive NE, Salem, OR 97310.

INFORMATION RETRIEVAL

Information storage and retrieval is one of the most fundamental aspects of human intellectual endeavor. Computers are a significant tool in this area, but they do not solve all of the problems. Far from this, they open up new fields of research and problems having to do with the use of computers for the storage and retrieval of information.

This OCCE Special Report is not meant to provide a comprehensive overview of the information retrieval field. But it is a good starting point if you have not previously studied the field, and it is a useful continuation for those who have studied in the field. The Report contains three sections. The first is a discussion of automatic indexing schemes. The most common of these is the Key Word in Context (KWIC) indexing system. If you are not familiar with KWIC then it is suggested that you read from the third section of the Report first. It gives some sample output from a demonstrated KWIC system.

The second section concerns Computer Output Microfilm (COM). It is a comprehensive overview of this aspect of information storage and retrieval. It also introduces the topic of Computer Input Microfilm (CIM).

All three sections of this Report were done by students at the University of Oregon. The first two were term projects in an Information Retrieval course taught by David Moursund of the Computer Science Department during Summer, 1977. The third section represents some of the work that Curt Torgerson did as reading projects during 1976-77 under Moursund's supervision.

Index

COMPUTERS IN THE ELEMENTARY SCHOOL
A COURSE FOR TEACHERS

Computers and calculators--electronic aids to information processing and to learning--are coming into the elementary school. This creates a substantial in-service and pre-service teaching training problem. The two papers which are enclosed are designed to help solve this problem. The first, Computers and Computational Aids: A First Course for Elementary School Teachers, is a fairly detailed outline for a course designed to give elementary teachers an introduction to computers and electronic calculators. Variations on this course will be tried out on five different college campuses in Oregon during winter quarter, 1975. A spring term conference is planned, to discuss and disseminate the results. It is expected that proceedings of this conference will be published in late spring, 1975.

The second paper is an annotated bibliography on The Instructional Use of Computers with Elementary and Preschool Children. It gives good insight into some of the literature in the field of computers in elementary education.

THE OREGON REPORT ON COMPUTING:

Future of Computers, With Implications for Education

CONFERENCE

Saturday May 14, 1977
Oregon State University, Corvallis
9:00AM-4:00PM

This conference received financial support from the Oregon System for Mathematics Education, and was co-sponsored by the Oregon Council for Computer Education and the Oregon State University Department of Computer Science.

CONTENTS OF THE PROCEEDINGS

Conference Directors

Dr. Ted Lewis
Dept. of Computer Science
Oregon State University
Corvallis, OR 97331

Dr. David Moursund
Dept. of Computer Science
University of Oregon
Eugene, Oregon 97403

One of the very best sources of information about the computer field is the CREATIVE COMPUTING magazine. It contains a wide variety of articles and ads. Much of the material is aimed at the computer novice, and much of the material is of interest to teachers and students. Moreover, educators are allowed to duplicate material from the magazine for use in their classrooms. All one is required to do is follow the rules in the box below.

OK To Reprint

Material in *Creative Computing* may be reprinted without permission by school and college publications, personal computing club newsletters, company house organs, and non-profit publications. Only original material may be reprinted; that is, you may not reprint a reprint. Also, each reprint must carry the following notice on the first page of the reprint in 7-point or larger type (you may cut out and use this notice if you wish):
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One-year subscription $15.00
Plese send us two copies of any publication that carries reprinted material. Send to attention, David Ahl.

TABLE 1 DELETED DUE TO COPYRIGHT RESTRICTIONS

The material reproduced to the right is from the article "Survey of Educator's Attitude Toward Computers" by David Lichtman. The article begins on page 48 of the January 1979 issue of Creative Computing.

The next 2½ pages of this paper are another article from the same issue of Creative Computing. It should be carefully studied by any person who teachers BASIC programming.

PAGES 55-57 DELETED DUE TO COPYRIGHT RESTRICTIONS

Sources of Information

THE ARITHMETIC TEACHER

published 8 times per year by
National Council of Teachers of Mathematics
1201 Sixteenth Street N.W.
Washington, D.C. 20036

Generally has an article or two on calculator use suitable for elementary or junior high arithmetic students.

Calculator Information Center

An outgrowth of the ERIC system that is a source of FREE calculator information in bibliographic form with short abstracts. See pages 61-62 for more details.

CREATIVE COMPUTING

published monthly by
Creative Computing
P.O. Box 789-M
Morristown, NJ 07960

A magazine designed for a wide variety of computer users. Topics include:

- program summaries & listings
- hardware evaluations
- programming hints
- special sections on PET, TRS-80, APPLE computers
- reports/opinions on various topics and uses of computers

Most issues have articles specifically related to education and many articles contain ideas useful to computer using educators.

The Illinois Series on EDUCATIONAL APPLICATION of COMPUTERS

A series of papers published by the
Department of Secondary Education
College of Education
University of Illinois at Urbana-Champaign
Urbana, IL 61801

See page 64 for a partial list of publications to date.

The MATHEMATICS TEACHER

published monthly September through May by
The National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22091

Frequently contains articles/activities on calculator or computer uses in the high school curriculum.

MECC (MINNESOTA EDUCATIONAL COMPUTING CONSORTIUM)
2520 Broadway Drive
(Hwy 280 at Broadway)
St. Paul, MN 55113

Another source of FREE information. The consortium is statewide and financed by the state. The information is in the form of a bi-monthly newsletter that provides general reports of some computing activities in Minnesota. The newsletter items seldom give detailed activities. See page 63.

The OREGON COMPUTING TEACHER

name changed to THE COMPUTING TEACHER

A cross between magazine, newsletter, and professional journal. Probably the best source of computers in education information over a wide variety of topics. See page 40 for more information.

PERSONAL COMPUTING

Published monthly by
Benwill Publishing Company
1050 Commonwealth Ave.
Boson, MA 02215

A magazine specifically oriented toward users of microcomputers. Articles cover a wide variety of topics and many discuss specific uses or programs. Issues frequently contain articles related to educational uses of computers.

T.H.E. Journal (Technological Horizons in Education)

Published six times per year by
Information Synergy, Inc.
P.O. Box 992
Acton, MA 01720

Articles discuss the use of various technologies (computer, video systems, etc.) in education. Topics are in the administrative area as well as instructional.

The titles mentioned above are listed because they generally offer information on a variety of topics. They should be considered as primary sources of general information. It is not uncommon to encounter articles that are applicable to the use in computers in education in many other professional and popular publications.

Readers with a good technical background in computer science will be interested in the publications of the Association for Computing Machinery and the publications of the Institute for Electrical and Electronics Engineering. Among the general audience, widely read publications one should consider are:

COMPUTER MUSIC
DR. DOBB'S JOURNAL OF COMPUTER CALISTHENTICS & ORTHODONTIA
INTERFACE AGE
KILOBAUD
RECREATIONAL COMPUTING
SMALL BUSINESS COMPUTERS MAGAZINE

Persons interested in computers in Education should also be aware of 2 other resources. Ron Tenison, President of OCCE, maintains a library of books pertinent to the field. An outdated listing can be found in The Oregon Computing Teacher, vol. 3 #2. A more current listing of titles is available from Ron at

Catlin Gabel School
8825 S.W. Barnes Rd.
Portland, OR 97225

A film bibliography prepared in 1977 by Doris Lidtke and published as an OCCE Special Report is available for $3.00 per copy plus $1.00 postage/handling per order. 425 titles are given with sources, cost, running time, year of production and whether black/white or color.

COMPUTERS AND COMPUTER APPLICATIONS:

A FILM BIBLIOGRAPHY

by Doris Lidtke

Looking for Information about Calculators?
So is the Calculator Information Center!

The Calculator Information Center has just been established by the National Institute of Education at the ERIC Center for Science, Mathematics, and Environmental Education. Why? To collect information about the use of calculators in elementary and secondary schools -- and to provide you with information. As recommended in the Report of the Conference on Needed Research and Development on Hand-Held Calculators in School Mathematics*,

> the information collection and dissemination process is important in furthering appropriate development and use of calculator materials by coordinating research and development efforts, avoiding needless duplication, and providing a source of knowledge and assistance . . .

Thus, the Center will

> (1) Develop an information data base . . . [so that] information on calculator activities in such places as local school systems, State agencies, universities, and industry will be routinely routed to the Center.
>
> (2) Develop an easy way to gain access to the information . . . (p. 45)

To help to establish the information base, you can send information to the Center:

- instructional applications
- studies on the effect of using calculators

(Materials will not be released or entered into the ERIC system without specific permission.)

From the Center you will be able to obtain:

- annotated bibliographies:
  - of curricular and instructional applications
  - with background information pertinent to educators
  - on research
- information bulletins on such topics as:
  - available commercial instructional materials
  - available non-commercial instructional materials
  - schools in which calculators are being used and which have indicated willingness to be contacted directly by those with specific questions
  - summaries of characteristics of various calculators
  - points to consider when selecting a calculator
  - aspects to consider when designing school-based studies
  - other topics as requests make a need evident

If you have information to share, or if you wish to learn what others are doing with calculators, contact: M. N. Suydam, Director
Calculator Information Center
1200 Chambers Road
Columbus, Ohio 43212

Or phone: 614-422-8509 between 9 and 5 (Eastern time zone)

---

* Copies of the report can be obtained from the Calculator Information Center or from E. Esty, Mail Stop 7, NIE, 1200 19th St., NW, Washington, D.C. 20208.

Calculator Information Center
1200 Chambers Road
Columbus, Ohio 43212
(Phone: 614-422-8509)

PLEASE COMPLETE AND RETURN TO THE ABOVE ADDRESS!

If you would like to continue to have your name on the Center's mailing list, please check here: /__/

The Center has developed five reference bulletins to date. If you would like any of them, please put a check in the box:

Bulletin		Topic	Focus
/__/	1	Some Selected Articles: Activities with Hand-Held Calculators	instruction
/__/	2	Research on Hand-Held Calculators	research (annotated)
/__/	3	Research on Desk Calculators	research (annotated)
/__/	4	Pros and Cons of Using the Hand-Held Calculator	general
/__/	5	College-Level References on Calculators	instruction, research (annotated)

Additional bulletins are being prepared. Please indicate the type of material in which you are interested, so you can be sent bulletins as they are ready:

		Circle level		
/__/	References to instructional applications	elementary	secondary	college
/__/	References to research	elementary	secondary	college
/__/	References to commercial materials	elementary	secondary	college
/__/	References on general concerns	elementary	secondary	college

Please PRINT your name and address:

Name: ______________________________

Address: ______________________________

______________________________ Zip Code ________

If you know of other persons interested in calculators, please make copies of this page for them (or send us their names and addresses).

GOVERNOR'S BUDGET RECOMMENDATIONS

In his budget address to the Legislature, Governor Perpich recommended that MECC be supported at the levels requested by the Department of Education, the State Community College System, the State University System, and the University of Minnesota. These member system requests were included in their respective 1978-79 biennial budget. Approximately $4,100,000 for 1978 and $4,600,000 for 1979 were requested by the member systems for services through MECC. The member system budgets currently are undergoing review by Senate and House Committees.

INSTRUCTIONAL TIMESHARING

Service is the measure of instructional timesharing. The computer in addition to having the desired features and capabilities must deliver stable, reliable and fast service. The MECC U1110 is now doing just that.

Unfortunately, during the 1975-76 school year some poor service lead to a situation mutually unsatisfactory to UNIVAC and MECC. As a result, the long term contract was cancelled and the U1110 stayed on a month-to-month basis. Now MECC is faced with acquiring a replacement service.

The replacement service will be provided by a computer yet to be determined. The central site computer will serve approximately 300 ports with the potential to grow to at least 375 ports of service. The specifications for the system were released to potential bidders on February 19, 1977. All interested bidders must respond by April 1, 1977, and be willing to install equipment to operate beginning with school opening in the Fall of 1977.

The winning bidder, that is, **the one meeting all specifications and offering the lowest cost to MECC**, must provide equipment that is compatible with the existing communications network and must provide the necessary conversion assistance to get users operational.

The MECC Instructional Services staff plans to work diligently over the summer to have the service **on-the-air** when school opens.

COMMUNICATIONS ARE VITAL

MINNESOTA EDUCATIONAL COMPUTING CONSORTIUM
2520 Broadway Drive
(Hwy. 280 at Broadway)
St Paul, MN 55113
Telephone (612) 376-1122

The state of Minnesota puts considerable money into instructional computing. The population of Minnesota is about twice that of Oregon. Because of the money provided by the state legislature, Minnesota has become a (the?) leading state in the instructional use of computers at the precollege level. MECC's newsletter is free; use the form given below.

We would like to mail SYSTEMS UPDATE to all interested individuals within our budget capability. Please indicate below if you wish to be added to our list. IF YOU ARE ALREADY ON AND WISH TO BE DROPPED OR HAVE YOUR INFORMATION CHANGED, PLEASE USE THIS SAME FORM.

PLEASE add ______, change ______, delete ______ my name address.

(PLEASE PRINT ALL INFORMATION)

NAME ______________________________
Last Name First Name Middle Name

POSITION ______________________ REGION __________

AGENCY, FIRM or INSTITUTION ______________________

MAILING ADDRESS ______________________

____
City State Zip Code

Return to: 2520 Broadway Drive, St. Paul, Mn. 55113

Quoted below are excerpts of a letter from Professor Bruce Hicks to David Moursund that discusses ISEAC. Selected titles from the series are also provided.

University of Illinois at Urbana-Champaign

College of Education
DEPARTMENT OF SECONDARY EDUCATION
Education Building
Urbana, Illinois 61801
(217) 333-0227

Resource Materials for Teacher Education

During the 1978-79 academic year we shall be publishing a special set of ISEAC reports in addition to our regular monographs. This special set will contain resource materials for a variety of post-secondary teacher education programs in educational application of computers. There will be approximately 15 titles in the complete set. All documents will be available by late summer 1979.

The ISEAC reports are distributed free to some 140 people in the US and Canada, the majority being in Illinois. We add names to the mailing list as requests come in. In the future we will decide whether to make a nominal charge to cover costs of mailing and reproduction.

Publication Date	Number	Report
3/75	1*	Applications of Computers in the Whole School-Five Examples. Goddard and Hicks
2/75	2	A Study of Computer Simulations for Environmental Science Education. Dirks, Singletary and Hicks
8/75	3*	Students: Where the Action Is! Hicks, Goddard and Keasler
3/76	4	The Use of Computers for Instructional Purposes - A Preliminary Survey of Selected Secondary Schools in Illinois. Berryman, Doring and O'Rourke
11/77	23	Documentation of Courseware Libraries. Dennis and Rhodes
6/77	24	Computer Activities in Illinois Secondary Schools. Dennis, Dillhunt and Muiznieks
10/78	25	A Multi-Purpose Educational Medium - MC Painting. Zibit and Hicks
11/78	26	A General Introduction to Microcomputers.

*Republished, in modified form, as "Computers for the Whole School", (Hicks, Ed.), People's Computer Co. (Menlo Park, 1977).

ACM Elementary and Secondary Schools Subcommittee

The Association for Computing Machinery (ACM) is a professional computer society with over 40,000 members. The ACM organization includes an Education Board that is concerned with education at all levels. The Elementary and Secondary Schools Subcommittee (ES^3) is concerned with all aspects of instructional use of computers at the precollege level, as well as teacher preparation. The chairman of this subcommittee is David Moursund, one of the authors of this

ES^3 was established in June 1978. It has taken a grass roots approach to identifying problem areas. Via widespread announcements in various regional and national publications people were asked to list problems faced by the computer education field at the precollege level. To date about 600 people have responded to this request, and some 25 problem areas have been identified. A Task Group approach being used to attack these problems. Each Task Group consists of one or two leaders and a number of participants. Preliminary reports produced by the Task Groups are circulated to all people on the ES^3 mailing list (so send in your name if you are interested). About a half dozen of the Task Groups are chaired or co-chaired by people from the state of Oregon. Some of the Task Groups are described below. These were selected to give an indication of the wide variety of problems being attacked by ES^3. They also give an indication of the breadth of the computer education field.

Acquisition

Most people are not familiar with the overall process of computer acquisition. In addition to hardware, there is the major problem of software. This Task Group is addressing the overall problem of selecting and acquiring appropriate computer systems for use in an instructional setting.

Business Curriculum and Vocational Technology

The great majority of all computer usage is in the business field. What should students in secondary school business programs be learning about computers? For example, computerized word processing is becoming very common in modern business offices, but most secondary schools have not yet acquired instructional equipment in this area. Computer equipment is now part of some modern automobiles and is used in much process control equipment. Secondary School Vocational Technology programs need to adjust to this fact.

Computer Literacy

Leaders in the computer education field have established computer literacy as a number one computer education goal. All people graduating from our public school system should have an adequate knowledge of computers to cope with the computer-oriented aspects of life in our society. Thus each school system should have a plan for accomplishing this. Most don't!

Computer Science

Most high schools offer year long courses in biology, chemistry, and physics. It appears likely that eventually a year long computer science course will join these ranks. What should be its contents? What hardware, software, and teacher knowledge are needed to offer the course?

Elementary School Curriculum

How much access to calculators and computers is appropriate for elementary school students? What are appropriate goals in the use of these machines? In what ways will the content and process of elementary education change? These are difficult questions faced by every elementary school.

Software and Courseware Exchange

Perhaps the biggest bottleneck right now is the lack of appropriate software and courseware. Quite a lot of material has been prepared by individual teachers. But it needs to be screened, have its quality improved, and then disseminated. The Task Group chairpeople for this group are both from Oregon. One of them currently has a federal grant to work on the problem. She is an excellent source of information.

Judy Edwards, Director
Computer Technology
Northwest Regional Educational Lab
710 S.W. 2nd
Portland, OR 97204

Teacher Education

There is considerable need for inservice and preservice computer education courses for teachers. Four states now have a computer science teaching "norm" so that teachers can be certified in this field. A different section of this discusses some of the needed inservice and preservice courses.

The list of Task Groups (and difficult questions) goes on and on. ES^3 has Task Groups dealing with the Handicapped, with Mentally Gifted, with the Mathematics, Science, and Social Science curriculums, and with Minorities

and women. Each school and/or school district intending to make instructional use of computers is faced by all of these problems. ES^3 is an excellent source of information on how to solve them.

To get on the ES^3 mailing list:

David Moursund, Chairman
ACM Elementary & Secondary
Schools Subcommittee
Dept. of Computer Science
University of Oregon
Eugene, OR 97403

To get information about joining ACM:

Association for Computing Machinery
PO Box 12105
Church Street Station
New York, NY 10249

RESOURCE PEOPLE

Oregon is fortunate to have a large number of well qualified computer education resource people. Due to space limitations, many well qualified individuals are not included here. Each person listed below has resided in Oregon for quite a while and has been an active leader in computer education. An effort has been made to provide widespread geographical representation.

Howard Bailey
Dept. of Mathematics
Eastern Oregon State College
La Grande, Oregon 97850

Karen Beisse
Edgewood Elementary
577 East 46th
Eugene, Oregon 97405

Fred Board
Westfir Junior High
Westfir, Oregon 97492

Dale Bryson
Math Department
Umpqua Community College
Roseburg, Oregon 97470

David Dempster
Newport High
322 NE Eads
Newport, Oregon 97365

J. Michael Dunlap
Dept. of Computer Science
Willamette University
Salem, Oregon 97301

Philip East
Dept. of Computer Science
University of Oregon
Eugene, Oregon 97403

Judy Edwards
Northwest Regional Ed. Lab
710 S.W. 2nd
Portland, Oregon 97204

Keith Garrett
Ashland High School
Ashland, Oregon 97520

Robert Jaquiss, Sr.
North Salem High
765 14th Avenue NE
Salem, Oregon 97303

Herbert Jolliff
Mathematics Dept.
Oregon Institute of Technology
Klamath Falls, Oregon 97601

Tim Kelley
Computing Center
Southern Oregon State College
Ashland, Oregon 97520

Jerry Larer (DP Dept.)
North Clackamas School District
14213 SE Johnson Road
Milwaukie, Oregon 97222

David Moursund
Dept. of Computer Science
University of Oregon
Eugene, Oregon 97403

Mike Neill
Career Information System
Hendricks Hall
University of Oregon
Eugene, Oregon 97403

Dick Ricketts
Multnomah ESD
PO BOX 16657
Portland, Oregon 97216

Jean Rogers
Star Route, Box 151-A
Port Orford, Oregon 97465

Phil Ryan
Southwest Oregon Community College
Coos Bay, Oregon 97420

Jack Slingerland
Lewis and Clark College
0615 SW Palatine Hill Road
Portland, Oregon 97219

Keith Snuggerud
Oakridge High School
Oakridge, Oregon 97463

Ron Tenison
Catlin Gabel School
8825 S.W. Barnes Road
Portland, Oregon 97225

Wally Waldman
Blue Mountain Community College
Box 100
Pendleton, Oregon 98701