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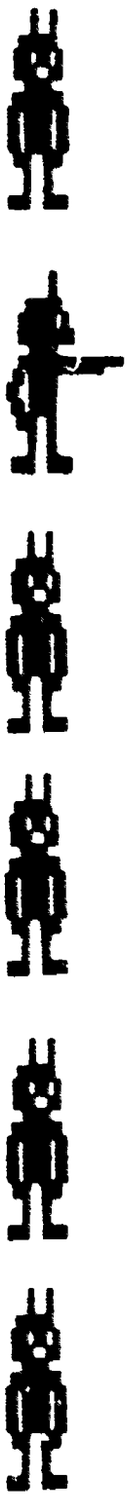
ABSTRACT

The second in a series on educational computing for teachers and administrators, this booklet offers a checklist for use in making decisions about program development, 11 case studies illustrating how teachers in Washington state have initiated programs, and a collection of articles on various aspects of educational computing programs. The checklist covers developing a plan, assessing readiness, designing instruction, computer placement, selecting software and hardware, funding, and inservice planning. Each of the 11 case studies includes a brief description of the setting, how interest began, steps taken, characteristics of the present program, and recommendations to others. The following article reprints are included in the resources: "How to Help Teachers Cross Over to Computers"; "Overcoming Fear of Unknown"; "An Approach to Integrating Computer Literacy into the K-8 Curriculum," by Beverly Hunter; "Evaluating Software: Be Hard on Software"; and "Choosing Hardware: Before Buying Computers." (LMM)

Computer Technology in Curriculum and Instruction Handbook



So You Want To Use Computers

So You Want To Use Computers

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"Computer figure" courtesy of Leo B. Christopherson, author of ANDROID NIM

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TABLE OF CONTENTS

INTRODUCTION

This booklet is the second in a series of booklets designed to help you get started using computers in the classroom. It contains two sections: a checklist for use in making decisions about building a program, and some case studies showing how others in the state have initiated programs. The content of both sections is based on information supplied by teachers and administrators who are already using computers in instructional programs, and has been reviewed by them prior to publication.

A SELF-ASSESSMENT CHECKLIST

The following checklist is designed for use by teachers and administrators who want to incorporate computer technology into instructional programs. It is intended as a self-assessment guide to making the necessary decisions for setting up a successful program, as suggested by practitioners who already have done so.

Administrators who wish to establish a department building or district-wide program will want to approach this checklist from a systemwide perspective when interpreting words such as "program" and "curriculum." Teachers, whose interest may be primarily in a single classroom or grade level, will want to interpret the questions in the checklist as they pertain to developing class units or courses.

The checklist covers the topics of developing a plan, assessing readiness, designing instruction, deciding where computers will be placed, selecting software and hardware, finding funding and planning for inservice. Some cross-referencing by the reader between sections may be useful, OR each section may be used by itself.

Each reader may not be able to make all the decisions the checklist addresses, but every reader should be able to determine in his or her own setting who needs to make those decisions and whether or not they have been made.

Each district or school using this guide will need to make individual decisions about where to begin (elementary, secondary, across-district, etc.) and how to coordinate within the district or between buildings.

References are intended to assist those who wish more in-depth discussion of the topics covered. Additional assistance is available from persons in the Practitioners' Directory in this series of booklets, from the Resources booklet, or from the Computer Technology in Curriculum and Instruction Information Exchange at (206) 753-2858.

A. DEVELOPING YOUR OVERALL PLAN (DISTRICT OR SCHOOL)

_____Have you developed a program plan?

_____Identified specific goals?

_____Identified specific long-range objectives?

_____short-range objectives?

_____Reviewed the research on computers in instruction?

_____Identified all who have roles in the program? All who can support the program?

_____teachers at pre-post-grade levels?

_____building administrators?

_____district administrators?

_____district purchasing agent?

_____parent groups (Advisory Councils, Title I, Voc Ed, PTSA,...)

_____others who will be affected?

_____Identified a coordinator for the program?

_____Identified members of an advisory group?

_____Determined how the program will be integrated with existing curriculum?

_____Made provision for all students equitably (i.e., checked to see that your program provides for both students who have previous experience or special expertise with computers and students who do not have this advantage?)

_____Determined if community use of the computers will be included?

_____Revised your plan to see that it includes all the necessary elements (goals, objectives, activities, timelines, evaluation)?

_____Reviewed this plan with others for logical sequence, continuity and completeness?

_____If yours is a district plan, have you determined -

_____Whether to begin at elementary, middle or secondary level?

_____How/when to move to other grade levels?

_____How to assure coordination between buildings?

References:

"An Agenda for Action," National Council of Teachers of Mathematics, 1980.

Bjorum, William, "A Plan for Introducing Microcomputers Into Instruction" The Computing Teacher, March, 1982 pp. 52-53.

B. ASSESSING READINESS

_____Have you surveyed those who will be affected to prepare them for the program?

_____Identified who's knowledgeable already? _____ Included students? _____ board members? _____ parents?

_____Identified who's interested?

_____Determined teachers' (users') familiarity with various computers?

_____Identified existing programs/people whose expertise can be drawn upon?

_____Made plans to visit other programs?

_____Developed ideas for overcoming lack of knowledge among those who will be affected?

References:

"How to Help Teachers Cross Over to Computers."

"Overcoming Fear of the Unknown," Education USA, Jan. 4, 1982, pp. 146-7.

Calkins, Andrew, "Three Administrators Who Made the Difference," Electronic Learning, Jan/Feb, 1982, pp. 30-31.

C. DESIGNING INSTRUCTION

Have you designed an instructional plan for using computers?

____Determined most appropriate subject areas for using computers?

____Reviewed existing curriculum in relevant subject area(s)?

____Reviewed available computer curriculum guides?

____Identified who should be included in designing this instruction?

____Teachers? ____Community people? ____Students?

____Collected ideas from these people?

____Identified objectives for this instruction?

____Identified activities to meet these objectives?

____Reviewed objectives and activities with those who contributed ideas?

____Coordinated objectives and activities with other teachers whose instruction will be affected? ____With appropriate administrators?

____Identified a means/sequence/process for field-testing and revising this instructional plan?

References:
Hunter, Beverly, "An Approach to Integrating Computer Literacy Into the K-8 Curriculum"

D. DECIDING WHERE TO PLACE COMPUTERS

Have you studied the choices available to you in placing computers?

_____Determined whether the instructional plan calls for mobile or stationary computer hardware?

_____Considered mobile units (carts)? _____computer lab set-up?

_____single units in classrooms? _____classroom networks?

_____Considered the need for possible future expansion of computer units?

_____Determined security needs? _____classroom networks?

_____Determined if adequate, uninterrupted power supply is available at each location being considered? _____number of circuits and outlets needed?

_____Determined who will be responsible for:

_____Maintenance?

_____Repair?

_____Inventory control?

_____Check-out?

_____Determined if equipment should be available for check-out?

_____to classrooms? _____overnight? _____over vacation periods?

_____Determined who will be authorized to check equipment out?

_____Planned an orientation for those who may check it out?

_____Planned for someone knowledgeable to be on call during the check-out period?

E. SELECTING SOFTWARE AND HARDWARE

SOFTWARE:

Have you reviewed the district Instructional Materials Selection Policy as it relates to computer software?

____Determined if the policy already covers software or is adequate to cover software?

____Determined the policy for basic and for supplemental materials (materials used as texts or primary materials, and materials used to supplement basic materials)?

____Determined if the instructional plan calls for basic or supplemental computer software?

____Considered recommending an Instructional Materials subcommittee for reviewing software?

Have you studied the software you wish to purchase?

____Determined if it can be previewed?

____Determined if evaluations are already available?

____Determined if this software supports the curriculum or will dictate it?

____Determined if this software is accompanied by documentation?

____Determined if the material is copyrighted?

____Determined if it can be returned once it is purchased?

____Determined if multiple copies will be needed?

Have you considered related questions?

____Determined if there are people in the district who could adapt/ revise this software for local needs?

____Determined if there are people in the district who could produce comparable software?

____Determined if there are licensing/duplicating arrangements available with this software?

____Determined if the district business office is willing to sign such arrangements?

Have you investigated online computer searching of evaluations for this software?

References:

"Evaluating Software: Be Hard on Software," Education USA, Jan. 4, 1982, p 146.
See booklet in this series:
Courseware Evaluation

HARDWARE:

Have you determined the kind of hardware you need?

____Reviewed the software to be used with the instructional program?

____Determined whether an individual classroom system or a district-wide system is needed? ____Is attainable?

____Weighed the merits of hardware that will be versatile and accommodate several instructional programs?

____Determined whether the need is for versatile hardware or for hardware that will be uniform for students/ teachers in a given program?

____Made comparisons of hardware from several vendors?

____Asked for the opportunity to preview several different machines from several vendors? ____for yourself and others in the district?

____Determined the extras that will be needed (e.g., insurance, maintenance, opportunity for trade-in later)?

Have you determined the hardware that is most appropriate for the instructional program you have designed?

____Determined what product support is available from the vendor?

____Determined the updating potential of this equipment (adding memory, for instance)?

____Found out if the vendor provides training in the use of this hardware?

____Investigated local user groups for this hardware (who can provide assistance, share software, etc.)?

____Determined if this hardware will accommodate data management needs as well as instructional needs? ___determined if this is a necessary feature of hardware you will purchase?

____Considered whether students will need to switch/have difficulty with switching to another brand of hardware from that which you are thinking of purchasing?

References:

Billings, Karen and Stephen Gass, "Adding a Micro to Your School Picture," Electronic Learning, Jan./Feb., 1982, pp. 35-40.

"Choosing Hardware: Before Buying Computers," Education USA, Jan. 4, 1982, p. 145.

F. FINDING FUNDING AND OTHER RESOURCES

Have you determined necessary costs?

_____Included costs of software, hardware, accessories, accompanying texts, supplies, other AV materials, inservice?

_____Included costs of maintenance and repair of equipment?

_____Determined continuing program costs past the initial investment?

_____Reviewed the current budget for other items which might be traded off or eliminated because an instructional computer is being established?

Have you reviewed the opportunities for fundirg/other resources?

_____Surveyed existing resources in your building/district?

_____Determined how other districts/buildings have funded programs using computers?

_____Brainstormed funding possibilities with others who will be affected by this program? _____district staff? _____parents? _____students? _____community persons/businesses?

References:

Finkel, LeRoy, "Buying a Micro: What Every Educator Should Know," Electronic Learning, Jan./Feb. 1982, p. 26 and 28.

G. PLANNING FOR INSERVICE

Have you developed a plan for inservice?

____Conferred with those who must approve the inservice plan?

____Identified the client group(s) the plan will address?

____Identified the particular needs and interests of this group?

____Identified the degree of training needed in using equipment, in order to meet your overall inservice goal?

____Reviewed the sequence of activities most desirable for the staff to be reached by the inservice?

____Determined who can provide the inservice? ____vendors?

____colleges? ____consultants? ____local district experts?

____Determined what people, materials and hardware resources are available to implement the plan?

____Considered how the inservice may be evaluated?

References:
See booklet in this series:
Design for Staff Development.

CASE STUDIES IN DEVELOPING PROGRAMS

The following case studies are designed to present at a glance various real scenarios for developing programs in schools around the state.

It is hoped that readers can gain relevant ideas from these experiences of others to apply in their own efforts to start programs.

The districts and schools remain anonymous, to protect them from over-exposure to contacts by others and to avoid the appearance of favoring or endorsing certain programs. Readers should refer to the Practitioners' Directory booklet in this series for specific persons to call for information about existing school and district programs.

CASE STUDIES IN DEVELOPING PROGRAMS

Elementary Programs

The setting:

City elementary school, enrollment 417.

How interest began:

Teachers identified mathematics as an area in which students needed remedial instruction. Teacher with computer interest and expertise reviewed available math software with other staff.

Steps taken:

Two available math software programs were found to be compatible with school's math scope and sequence.

Computer firms were contracted to identify the hardware which would be compatible with the software selected and with the school's needs.

Funds were obtained from the building capital outlay budget, the PTSA (for hardware), RAP and Title IV-B (for software).

Teacher with expertise provided 10 hours inservice training for teachers in using the hardware/software.

Characteristics of the present program:

Currently, three computers are in use six hours a day in the Resource Room for grades 1-6. Four more are needed. Programs are provided in math, reading, language arts, science and social studies.

Other teachers use the computers for creating word search and math dittos.

Recommendations to others:

Identify your need for computers before acquiring them.

Involve parents and teachers in the selection and let them know in advance what use you intend to make of the equipment and materials purchased.

CASE STUDIES IN DEVELOPING PROGRAMS

Secondary Programs

The setting:

Suburban high school, enrollment 1,400.

How interest began:

An opportunity to purchase hardware came when a new building program was begun and $20,000 became available within the building fund.

Steps taken:

Purchased three computers and nine terminals.

Hired math/science teacher with computer experience.

Obtained grants to purchase additional microcomputers.

Leased time on one system to provide funds for an additional terminal.

Expanded program to include math enrichment at middle school.

Characteristics of the present program:

Teach programming to grades 10-12 with 12 terminals.

Augment science courses, grades 9-12, with 12 terminals.

Teach lab math, grades 9-12, with 4 micros.

One micro at high school and two micros at middle schools now used to augment math classes.

Micros and terminals are used every period of the school day.

Currently, three teachers at high school and one teacher at each of the middle schools teach with the equipment.

Funds are budgeted for computers and terminals as part of regular school programs.

Recommendations to others:

Identify a person within school district as a computer program coordinator. Ensure that this person is knowledgeable and dedicated to computer education. Ensure that this person is available when needed.

CASE STUDIES IN DEVELOPING PROGRAMS

Secondary Programs

The setting:

Rural high school, enrollment 120

How interest began:

Teacher interest led to acquiring special training at the university level and at NSF summer institute. A supportive administration purchased first equipment for starting the program.

Steps taken:

Teaching with microcomputers began in mathematics classes.

Computer store contributed gift to the program.

Title IV-C mini-grant application was successful in bringing one more microcomputer to the program.

Programming was added to the curriculum.

The district purchased a third microcomputer and printer.

Computer literacy was added to the curriculum.

Characteristics of the present program:

Three microcomputers are in use six hours a day for teaching computer literacy, computer programming and mathematics, to grades 9-12.

One junior high school teacher has taught a programming unit and uses a microcomputer with 7th grade as well.

Levy failure has caused the cancellation of the computer literacy class.

Recommendations to others:

The support of the superintendent and the principal is a strong factor in the success of a program.

CASE STUDIES IN DEVELOPING PROGRAMS

Secondary Programs

The setting:

City high school, enrollment 1,500.

How interest began:

Teacher of existing computer science classes offered students an after-school clas, in building their own microcomputers.

Steps taken:

Students were selected for participation on the basis of interest.

Community experts, other teachers and students from existing computer courses were recruited as volunteers to provide segments of the intruction.

Students were rotated in groups through construction, digital electronics and programming units of study.

Two microcomputers were built in this way.

Characteristics of the present program:

Overall program: Computer concepts and computer programming are taught eight hours a day to 250 students per year.

Funds have come from special levy, district operating budget, student fund-raisers and private industry/business donations.

Two stand-alone and two time-sharing computers with a total of 10 stations are used in the program. One of these is a microcomputer with 9 terminals.

Recommendations to others:

Coordinate equipment purchases throughout the district. Software development/purchase and maintenance of hardware will be much improved if you do. Parts can be interchanged when repair is necessary, and so forth.

A time-sharing micro and dual density/dual sided disks will allow 4-8 terminals to be used productively with one computer.

CASE STUDIES IN DEVELOPING PROGRAMS

Secondary Programs

The setting:

City high school, enrollment 1,200.

How interest began:

A mathematics teacher with a special interest in computers arranged for 10 students to study Saturdays at the ESD computer center on a volunteer basis. The teacher conducted this program for two years before a programming class was established at the school itself.

Steps taken:

The teacher began a computer programming class using FORTRAN. Keypunching was done at the school with one-day turnaround time for printouts from the ESD.

A time-share system with seven terminals was established with another school (four terminals at this high school, three at the other school).

A separate class was established for the advanced students who had completed the first programming class.

An Alpha Microcomputer with six terminals was purchased for the growing program.

Instruction in BASIC was added to the program.

An introductory class was begun for students with insufficient academic backgrounds to enter the programming classes.

The introductory class evolved into a computer literacy class.

Additional microcomputers were purchased for portability and to encourage use by teachers in other subjects.

Characteristics of the present program:

Six classes offered each semester.

Three teachers in the program.

A total of eight terminals and six microcomputers in use in the school.

Some use by foreign language, history, business education and administrative staff, in addition to the math department.

Recommendations to others:

Plan your program carefully. Get assistance from districts with successful programs.

Plan your program before purchasing hardware to fit it.

CASE STUDIES IN DEVELOPING PROGRAMS

Districtwide Programs

The setting:

Small city school district, enrollment 4,077.

How interest began:

Interested secondary teachers took courses to study potential uses of computers in schools.

Administrators, teachers and members of the community pointed out the need for district high school graduates to gain the skills in technology needed for today's jobs.

Steps taken:

School Board support was gained for purchasing microcomputers and word processors for high school mathematics and business education courses.

A study group of local citizens was organized to evaluate need for K-12 programs.

The study group recommended pilot programs in elementary gifted programs.

The School Board visited gifted programs and agreed with administration that a further pilot was needed in using computers in other elementary programs and in the alternative high school.

Teachers with expertise were employed to provide inservice training in teaching with computers to other teachers; classes for teachers were offered in local college programs and through the community school program for adults.

Characteristics of the present program:

Computers are used in high school classes in mathematics and business education at the junior high school to teach computer awareness and literacy, and at the elementary schools to teach keyboarding and provide enrichment for the gifted students.

Library and school management uses for microcomputers and word processors have been developed and implemented.

Plans call for expansion of computer use into auto shop, drafting and design, economics, science and chemistry.

Recommendations to others:

Build a plan and gain support before placing computers in schools, but don't fail to make sure students gain experience with them.

CASE STUDIES IN DEVELOPING PROGRAMS

Districtwide Programs

The setting:

Suburban school district, enrollment 18,166.

How interest began:

Pressure from community, parents, school staff and students made a comprehensive computer literacy program for the district imperative.

Steps taken:

A needs assessment task force was created by the district administration.

District needs were identified and goals set for a minimum computer literacy program for all students.

A project leader was named from within the district. This person is a science teacher with experience with computers.

The literacy program was begun, rotating through junior high school science classes throughout the district.

Class materials were written and published.

Steps taken in the program were documented and results of the program were evaluated, showing sufficient growth and positive student attitudes.

Characteristics of the present program:

1500 students, grades 7-9, are being successfully taught the history of computers and simple programming (six basic computer commands and operations).

High school students receive more advanced computer education in business education, math and science classes.

A districtwide curriculum sequence is being developed.

Implementation of the elementary component is scheduled for '83-84.

Recommendations to others:

Develop a scope and sequence regardless of where first program is initiated.

Training of staff is key. Choose appropriate methods and small steps for training. Don't be too anxious to train all staff members at once.

CASE STUDIES IN DEVELOPING PROGRAMS

Districtwide Programs

The setting:

City school district, enrollment 15,300.

How interest began:

Program supervisors at the district level identified the need.

Steps taken:

The district learning resources supervisor and curriculum supervisors developed a beginning, three-year computer curriculum program for the district.

Approval was obtained to proceed.

District basic education and Title-IV B funds were used to obtain microcomputers and software.

District personnel with expertise is providing a three-year inservice training program for all teachers and administrators.

A district pilot program has been implemented to field test the curriculum and inservice programs.

A district technology study committee will review results of this as well as other programs.

Characteristics of the present program:

District pilot program uses 12 microcomputers circulated from the district learning resources center for use with 3,000 students in all curriculum areas.

Funding for continuation is provided within the existing district budget.

Computer literacy courses will be offered at the junior high level during the 1982-83 school year.

Recommendations to others:

Do not begin a program without written clarification of the district goals and objectives for computer instruction and clearly defined direction.

Determine who will be responsible for coordinating the program.

Allow sufficient time for software evaluation, including time for becoming familiar with the equipment required.

CASE STUDIES IN DEVELOPING PROGRAMS

Districtwide Programs

The setting:

Suburban school district, enrollment 16,000.

How interest began:

Administrative staff attended a conference on computer assisted instruction.

Steps taken:

District obtained special incentive grant (Title I) for purchase of equipment and salaries for staff.

Several staff visited CAI sites in California.

District funds were committed and additional Title I grant applications were sucessful.

A minicomputer with 78 terminals was installed with CAI programs in math, reading and language arts.

On going workshops (inservice training) are conducted for teachers and administrators.

Characteristics of the present program:

CAI system is dedicated to drill and practice in math, reading and language arts. Expansion of these programs for use in special education and in gifted programs is contemplated.

1,500 students per 7-hour day use the system.

New software, as available, is purchased.

An additional project uses the system for managing student learning objectives, using a teacher written program.

The project provides prescriptive print outs for teachers on student progress toward meeting SLO's and appropriate materials for the student's next assignments.

All district staff has opportunity for inservice training at several levels of sophistication.

Recommendations to others:

Provide maximum support by well trained staff.

Integrate computer program into the curriculum wherever possible.

Provide ongoing inservice and keep in touch with latest developments.

Encourage multiple uses of the equipment. Don't draw a hard line between instructional and administrative uses.

Administrative support is most valuable.

CASE STUDIES IN DEVELOPING PROGRAMS

Districtwide Programs

The setting:

Rural school district, enrollment 300.

How interest began:

A teacher applied for, and received, a National Science Foundation grant to study computer use.

Steps taken:

The teacher began a computer programming course, with student written programs sent to an out-of-state computer with a one-week turnaround time.

Access to an instate computer was obtained with funds from a mini-grant, in cooperation with a community college, using a terminal to access a state university computer.

A second successful mini-grant financed acquisition of a microcomputer for use in mathematics classes.

Characteristics of the present program:

One high school teacher conducts computer programming classes.

High school students in turn teach elementary students.

One microcomputer rotates through grades 1-8.

Major emphasis in computer classes is on computer awareness and literacy.

Recommendations to others:

Work for participation by as many school staff as possible.

Administration support is essential.

CASE STUDIES IN DEVELOPING PROGRAMS

Districtwide Programs

The setting:

Rural school district, enrollment 3,030.

How interest began:

A middle school teacher, who had his own computer, and a second teacher, who wanted to institute a program district wide, generated the initial ideas.

An administrator wrote a successful Title IV-C grant to obtain computers for instruction.

Steps taken:

One teacher instructed his class in letter writing; students wrote to several corporations, requesting funds to purchase a computer for class use. They were successful by year's end.

Other teachers followed with similar fund raising projects.

Additional funds were obtained from a Title II-Basic Skills grant.

Program directors for other programs became interested and purchased additional computers with categorical funds.

Characteristics of the present program:

Programs are currently ongoing in all program areas, K-12, including remedial, gifted, special areas and regular programs.

Recommendations to others:

Teachers with an initial interest may take up to one school year to become active users of computers in the classroom.

Three criteria are a must in considering the purchase of hardware:

1. What software is available and is it compatible with the hardware being considered?
2. What are the expansion capabilities of the software?
3. What are the expansion capabilities of the hardware?

REFERENCES

HOW TO HELP TEACHERS CROSS OVER TO COMPUTERS

Education USA/January 4, 1982

If teacher fear of the unknown is an obstacle to computer literacy in the classroom, then the solution for school districts wishing to enter the era is clear. Take technology from the realm of the unknown for teachers and put it into that of the known.

A teacher doesn't have to know the engineering wizardry or how to program it, only how to make it accessible to students. And according to Cheryl Anderson, assistant professor of curriculum and instruction at the University of Texas, it can be done in a six-week inservice course.

Writing for Electronic Learning, Anderson said she has developed such a course that can be taught after school or in the evenings. There should be at least one terminal for every two or three participants. Here is a synopsis of her course.

WEEK ONE

Session 1. This should be geared toward an introduction to computers and should include some hands-on experience. Anderson uses videotapes of teachers, parents and students who have good things to say about computers. Teachers run short, simple and fun programs.

Session 2. Anderson explains computer literacy and why it is relevant to teachers and uses a film to explain the history of computers. Then are the components of the computer discussed.

WEEK TWO

Sessions 3 and 4. Using commercial transparencies, teachers are taught basic commands and simple statements. Anderson gives teachers an opportunity to write and run their own simple programs.

WEEK THREE

Session 5. Teachers learn to type and run programs on the screen, giving them the opportunity to see the graphics of a computer.

Session 6. Teachers are introduced to instructional strategies, such as drill and practice, games, problem solving and testing.

WEEK FOUR

Session 7. Teachers learn to develop criteria for software, since very few of them will produce programs.

Session 8. Teachers hear different hardware vendors. Anderson also suggests evaluation sheets for teachers to use when comparing different machines.

WEEK FIVE

Session 9. Teachers receive resource lists for instructional materials that teach computer literacy to help them develop curricula.

Session 10. Teachers learn about funding sources.

Session 11. Teachers already using computers in their classrooms are asked to participate in a panel discussion with Anderson having them discuss both negative and positive aspects of the computer.

Session 12. In the final session, the future of technology in education is discussed.

OVERCOMING FEAR OF UNKNOWN

Education USA/January 4, 1982

Teachers often fear computers, concerned about a threatened lack of classroom control, equipment failure, more paperwork and inadequate supporting materials. But they also fear looking ridiculous in front of their students if they make mistakes with computers.

Bill Futrell, math and science consultant for the Wyoming State Department of Education, put it this way: "Some people (teachers) have a fear of tearing up an expensive machine....Actually, there is really very little damage you can do." Futrell said attitudes are changing, but it is a slow process. "We have teachers whose greatest innovation in 20 years is using colored chalk. They simply resist change in any form," he said.

In an article in Educational Horizons, Louise Grinstein and Rina Yarmish attempted to dispel some of the "myths" associated with computers.

The authors contend computers are classroom supplements, nothing more. "The 'human touch' is a vital element in the education process," they said. Computers cannot administer discipline, supervision or guidance. Nor can they serve as role models.

Does the use of computers in the classroom decrease interaction between students and teachers? In three studies for the Northwest Regional Education Laboratory, teacher-student interaction increased in two studies, usually because computer technology freed the teacher from other tasks. In the case where students using CAI received less of their teacher's time, a benefit was derived--increased self-reliance.

Students with access to computer-assisted instruction find it exciting and, according to reports assembled by NREL, they learn more and more quickly.

Two University of Texas statistics teachers conducted a study of computer fear among students enrolled in introductory data analysis classes. The teachers found that students are more afraid of computers if they see themselves as trial-and-error problem-solvers rather than as analysts, have lower grade point averages and have low test scores in math.

After becoming familiar with computers, the percentage of students fearing them dropped from 22% to 12%.

AN APPROACH TO INTEGRATING COMPUTER LITERACY INTO THE K-8 CURRICULUM[1]

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This paper describes an approach to integrating computer literacy into grades K-8, and the reasons for that approach. A key idea in the approach is "a modesty of aims," because of discrepancies between computer literacy needs, existing curricula, and learning resources.

Computer literacy may be defined as, "whatever a person needs to know and do with computers in order to function competently in our information-based society." This definition highlights the fact that specific skills, knowledge, and values required will vary from person to person, from job to job, and from time to time. Specialized knowledge required for a career as a computer designer, programmer, technician, or analyst is usually excluded from the computer literacy domain. Content areas often included in "computer literacy" are summarized below.

- Impact of computing on society, my work, my institution
- Applications in various fields
- Programming and problem solving
- Hardware/software/systems
- Awareness of careers
- Personal tool for learning and working
- Control over machines, systems
- Ethical, responsible behavior ← → information systems

Long Range Goals

Eventually, students and teachers will have many tools of our information-based society available to them as a normal part of their work and study. Information retrieval, data analysis, computation aids, simulations, word processing, drills, tutorials, dialogues, various high-level programming languages--these and other computer applications will be a normal part of a person's repertoire of resources for learning and thinking. Use of such resources will stimulate changes in curricula. Students will be expected to be more productive than they are now, and to deal with more complex phenomena.

As they learn to use these tools in their studies, students should be taught such things as dangers of inappropriate dependence on machines, sources of errors in systems and programs, appropriate and inappropriate uses of information systems, ethics of information use and misuse. A summary of purposes for a K-8 computer literacy program is shown as Figure 1.

[1] Based on a presentation for National Educational Computer Conference, June 24, 1980. This work is supported by the National Science Foundation Development in Science Education (DISE), Grant No. SED79 25654.

- Help students and teachers to value computers as general purpose machines designed, built and operated by humans to assist in many tasks.
- Encourage teachers and students to find and create computer applications that are useful to them in teaching, learning, managing information and solving problems in math, science and social studies.
- Help students and teachers to develop a sense of control over computers and to learn a variety of tools and techniques for exercising that control.
- Help students and teachers learn to use computers as an aid in solving problems. This should have the side effect of increasing the emphasis on problem solving in the classroom and increasing the variety of problems addressed.
- Encourage teachers and students to behave in an ethical and responsible manner in relation to the computers and information systems they use.
- Help students and teachers to become aware of a variety of computer applications and their uses by individuals and organizations.
- Help students and teachers learn to evaluate advantages, disadvantages and limitations of particular computer applications.
- Help teachers and students to become aware of ways computers affect groups and individuals, thereby helping to prepare students for responsible citizenship.
- Help students and teachers become aware of computer-related skills and experience that are important in a variety of careers.

Figure 1. Purposes of a Computer Literacy Program for Grades K-8

Diverse Perceptions of the Need

Awareness of the need for computer literacy for citizens, workers, and school children is now spreading very rapidly. Ten years ago, only a handful of educators used the phrase "computer literacy." Conferences on educational computing didn't have a category for papers or panels on the subject. When the idea was discussed, it was usually with regard to college students, scientists, or managers.

Various reasons for the computer literacy need are:

- Information-based society: discontinuity in educational needs.
- Technological competition: need to increase productivity of U.S.
- Equity of educational opportunity.
- Computer an indispensable tool—science, business, government.
- Need to take control over machines.
- Computers, calculators make some subjects obsolete.
- Need to learn tools for dealing with complex phenomena.
- Most careers are computer related.

Educational equity is a key reason for addressing computer literacy in the K-8 grades. If you want to reach all students, you have to do it before they start making critical choices in high school about their electives.

Equity is extremely important because of the rapidly developing gap between the haves and have-nots in this society, where access to information and the intellectual skills to use it are keys to achievement. A recent true story may help to illustrate my point. Laura and her brother, Dave, are in the 9th and 7th grades. This year, Laura was assigned a term paper on the subject of lycra, a synthetic fabric used in fashion design. Dave was assigned a science paper on the subject of the black-footed ferret, a nearly extinct animal.' Their father works for Mead Data Central, the company that provides NEXIS and LEXIS services. NEXIS provides, on line, the full text of news magazines, The Washington Post, Associated Press, and other news services. LEXIS provides the same kind of service for legal information. Laura keyed in "LYCRA" on the NEXIS system, and retrieved four recent AP stories from Paris about fashions, how to handle the material, how it's made. It took her about a half hour to retrieve the information and write the paper, including full citations. Dave keyed in BLACK FOOTED FERRET on the LEXIS system, and got full text of recent judicial decisions relating to habitat, status, and protection of this endangered species. His paper, too, contained complete citations to recent, relevant literature. Needless to say, both children got A pluses on their papers.

Our society is evolving so rapidly into an information-based world that different people have very different perceptions of the needs for computer literacy. A strategy for addressing computer literacy in school curricula must take into account this diversity of perceptions on the part of parents, school board members, administrators, staff, teachers, and students.

Discontinuity of Educational Needs

The shift to an information-based economy has produced what Andrew Molnar has termed a "discontinuity" in educational needs (Molnar, 1978). A list of over 400 course goals in computer education for grades K-12 produced by the Tri-County Task Force in Multnomah County, Oregon (1979) illustrates this point. If one assumes that teachers and students are not in the future going to spend more time and energy in learning and teaching than they presently do, then new goals must replace or modify old ones. This will require reordering priorities in math, science, and social studies curricula.

At the same time, the need for computer literacy is only one of myriad pressures on the schools for curriculum change. Career awareness, minimal competencies, back-to-basics, life-role skills, ecology and environment, energy, and equity for women and minorities are some of the other concerns. Computer uses should support, rather than compete with, these other goals and priorities.

Approaches to Satisfying Needs for Computer Literacy

In a study we conducted a couple years ago, we found schools and school districts around the country trying a variety of approaches in order to satisfy needs for computer literacy (Hunter and Hargan, 1979). Some of these approaches are summarized in Figures 2 and 3. They focus on various dimensions of the problem--teacher training, equipment, curriculum development--and emphasize one or more of the subject areas listed earlier. These approaches have had varying degrees of success as measured by the proportion of students and teachers reached, stability of the programs, and learning outcomes achieved. Most of these approaches lacked systematic integration of a developmental sequence of learning outcomes into the existing curriculum, but establish a local base of support and expertise upon which to build.

District Plan for Instructional Computing
Required Literacy Course – Junior High
Literacy Units in Math Classes – Junior High
Elective Computer Courses
Study Units in Other Courses
Computer Clubs
Community Involvement
Equipment Availability
Teacher Training

Figure 2. Strategy Examples

School/District	Target
Richardson ISD Texas	All 8th Grades; Interested High School Students
San Jose USD California	Junior High
Huntington Beach USD California	Board of Trustees; Administrators; Faculty and Staff; Interested Students
Highline SD Washington	All Students
A.I. duPont SD Delaware	8th Grade Math
Teaneck HS New Jersey	All Students and Teachers
Maple Lake HS Minnesota	All 8th Graders; Teachers; Most Other Students
Sehome HS Washington	Motivated High School Students
Riverdale Country School New York	All 8th & 10th Graders; Teachers; Most Other Students

Figure 3. Targets for Computer Literacy Programs

K-8 Infusion Approach

The approach we are developing establishes a process for infusing computer literacy objectives into the existing curriculum, using whatever materials and equipment are available. This idea was suggested to me by Kay Morgan, who had seen the need at Montgomery County Public Schools for a more systematic integration of computer literacy into the curriculum. Part of this idea is represented schematically in Figure 4. It appears that the overlap between existing curricula, computer literacy goals, and available resources is at present quite small. This is why I suggest a modesty of aims in the short run. However, I think in the long run this strategy will have the most productive results. While only a few of the possible computer literacy goals will be addressed initially, these goals most directly support existing curriculum goals in math, social studies, and science. At Montgomery County Public Schools, the school board members, administrators, staff, and teachers have repeatedly made the point that the computer literacy goals and activities must support existing curricula. As classroom computing experience is gained by more and more teachers and students, integration of more computer-related goals will become easier. It is to be hoped that this effort will in turn stimulate developers and publishers to provide more classroom materials and computer programs to support these educational goals.

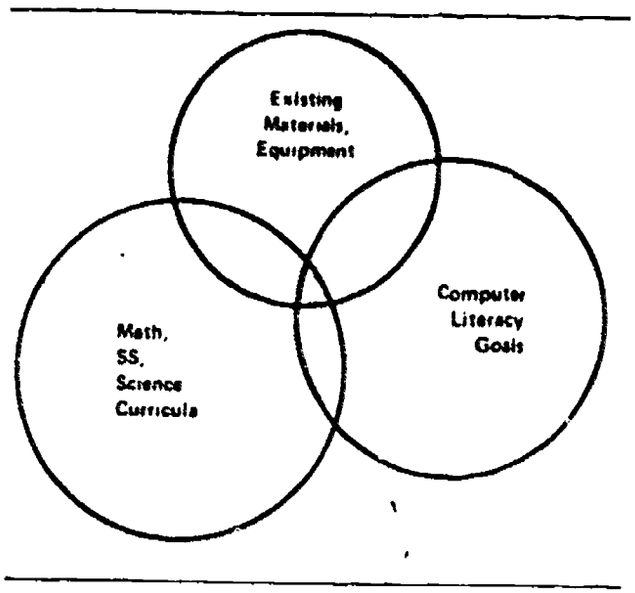

Figure 4 Modesty of Aims

Curricula Guide for K-8 Computer Literacy

In mid-April of 1980, we at HumRRO joined with Montgomery County Public Schools and educators across the country to develop a guide on computer literacy for grades K-8. This project is supported by a grant from the National Science Foundation's program, Development in Science Education (DISE). In this project, we will produce a series of guides for use by school administrators, media center people, teachers for grades K-8, and

subject coordinators. The guides will include statements of learning outcomes, targeted toward: grade levels; math, social studies and science subject areas; and topics. Along with each outcome/grade level/subject area, will be suggestions for classroom activities and learning resources to support the objective. Teacher training guidance will also be included.

Major Activities

Figure 5 lists the major activities involved. A group of about sixteen people from around the country participated in an effort to define a minimal set of learning outcomes in computer literacy. These are people who have thought about and worked with children and computers from various perspectives: math, social studies, or science education; teacher training; curricular materials development; program implementation in schools; educational research.

Major Activities	Who?
Define about 40 learning outcomes	National Panel of Experts
Search for learning materials and activities	HumRRO; Publishers, Vendors; Clearinghouses
Place outcomes into grade levels, subject areas, topics	MCPS Educational Specialists and teachers
Suggest activities, materials	HumRRO; suppliers
Train teachers–Pilot Schools	HumRRO; MCPS
Try Out and Evaluate	HumRRO, MCPS; other field test sites
Revise and Produce Guides	HumRRO; suppliers
Disseminate	Publisher
(National Field Tests)	

Figure 5. Major Activities in the Project

Guided by a list of learning outcomes agreed upon by the panel of experts, we are searching for existing computer programs, films, books, magazine articles, and other materials or activities that might be used to learn and teach these subjects. We are looking especially for activities that would support both a computer literacy objective and objectives in the traditional curricula. In this activity, we are highly dependent upon efforts of clearinghouses, resource centers, catalogers, publishers, and vendors.

Learning outcomes are being submitted to a curriculum jury in Montgomery County Public Schools. This jury includes about twenty curriculum specialists for K-8 math, science, and social studies, and about twenty-five K-8 teachers and school principles who have had experience in classroom uses of computers. Through an iterative series of

questionnaires, the jury is placing the outcomes into appropriate grade levels, subject areas, and topics. The outcome of this activity will be a sequence of objectives, by grade level, course (math, social studies, or science), and topic. Our curriculum jury will not be able to find an appropriate place in the existing curriculum for all computer literacy outcomes. Thus, we may supplement the infusion strategy with a mini-course that addresses these extra computer literacy goals.

For each computer literacy outcome, at each grade level, course, and topic, one or more classroom activities will be suggested. In as many cases as possible, we suggest activities that do not require access to equipment as well as activities that do require access. We are suggesting materials and activities that are available from the most reliable suppliers. We do not in this project have the resources to evaluate or improve these materials or to develop new materials.

After we have organized this and other information into a curriculum kit or guide, we will try it out in pilot schools at Montgomery County. This tryout includes a limited amount of teacher training. One outcome of this activity will be guidance on the amount and type of teacher training that is essential, and how to provide it.

To test the generalizability of our methods and content, tryouts will be conducted in at least two other school districts in addition to Montgomery County. Later, there should be a broader field test nationally.

We intend for the guide to be disseminated by an established publisher of educational materials, and are discussing this with a number of candidate publishers.

Pros and Cons of Infusion Approach

The infusion approach as we have described it appears to have both advantages and disadvantages as compared with some other approaches that are being tried. Some of the apparent advantages are:

- Universal Computer Literacy
- Minimization of Teacher Load
- Minimization of Teacher Training Required
- Developmental Sequence
- Continuity for Educators
- Content-Context
- Relevance to Students' Work

By choosing the K-8 grade range, we are directly addressing universal computer literacy and the need for equity in educational opportunity. By choosing just a minimal set of objectives and spreading them out over the grades and subject areas, we minimize the load on individual teachers and the amount of teacher training required. Also, in this way we begin to address the issues of sequencing computer literacy skills and knowledge in a way that takes child development into account.

To me, the most compelling argument for the infusion approach, as opposed to trying to add computer literacy courses, has to do with the real substance of computer literacy. The whole point of computers in our information-based society is to provide us with the tools we need to solve problems, to augment our intellects, and to give us relevant information when we need it. For a young student, this means tools to use in learning and doing math, science, social studies, and whatever else he/she is learning. The infusion approach attempts to provide these tools in a manner and context that is clearly relevant to the students' work.

Finally, as indicated earlier, different people have different perceptions of the need for computer literacy; there are some people who do not perceive these needs and are opposed to this intrusion on the basic curriculum. By providing support to the existing curriculum, we help to bridge the gap between the past and the future.

Some limitations and problems with infusion, at least in the way we are going about it, are:

- Need strong commitment from Board and Administration of school district
- Require participation of many people, and literacy on their part
- Need teacher training
- Need activities and materials to support objectives
- Equipment scheduling more complex
- Need hooks into existing curriculum
- Also need infusion in language arts, humanities
- Don't yet have sequence based on developmental stages

A school district must have a strong commitment from the Board of Education and the administration in order to provide the policies and resources needed to establish goals and implement systematic curriculum change. Studies we have made of the history of computer use for instruction in schools around the country suggest that such commitment takes many years to build. Related to this is the fact that infusion requires participation of many people in a school district and a basic level of computer literacy on the part of curriculum specialists and teachers. Even in relatively computer-advantaged school districts, many social studies, math, and science curriculum specialists have not yet achieved that level of literacy themselves.

Our project does not directly address the tremendous teacher training problem caused by the computer revolution. Some have suggested that one approach would be to concentrate all possible resources on teacher training for the next few years and then make the infusion effort. I think we need both strategies.

The infusion approach is highly dependent upon the existence of classroom activities and learning materials to support both computer literacy goals and existing curriculum goals. While such resources are presently limited and of uneven quality, I believe that our guides (as well as other factors) will stimulate development of appropriate materials. A related problem has to do with computer equipment. The infusion approach will involve more complex scheduling of equipment, to make it available to many different groups of students, than would an approach that involved a special computer literacy course. Further, a large school district may find it difficult to provide equal access to equipment among the many schools in the district.

Another problem alluded to earlier is that of finding "hooks" into the existing curriculum. The fundamentals of computer programming, for example, are probably best learned as the focus of study and not as part of math, science or social studies.

Our project does not address language arts and humanities curricula, but these are also important areas for infusion of computer literacy.

Another limitation at present is the lack of research on which to base a sequence on hierarchy of skills and concepts to be learned. Much research needs to be done in areas of cognitive development and individual differences with respect to the acquisition of information-handling skills and knowledge, before educators can with confidence decide the appropriate grade levels for introduction of these ideas and activities.

Conclusion

Skills, knowledge, and values related to computers and information systems must be integrated into the education of all citizens. Our approach is to provide guidance on high-priority learning outcomes in computer literacy and to fit these outcomes into the existing math, science and social studies curricula in grades K-8. Some of the resources needed to fully implement this approach are now lacking in most school districts. Therefore, a modesty of aims is called for. However, we hope to facilitate the process by providing a map that shows how to travel from existing roads into the new territory.

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Evaluating Software: Be Hard on Software

Education USA/January 4, 1982

The selection of a computer for an instructional program is only the beginning. A more important step is to cull inadequate material from the many different types of software, or programming, in order to provide quality instruction.

Most software has been designed for uses other than educational, according to a recent article in Electronic Learning. Also, much of the software was produced by programmers who are not educators.

Henry Olds Jr. of Educational Development Corp. of Cambridge, Mass., puts it more bluntly. "Many educational software developers are clearly skeptical about whether teachers would appreciate quality if they could get it," he said in an article in Classroom Computer News.

How does one find quality? Guidelines are available from various sources. Quoting a consensus of experts, Electronic Learning said software should:

- Be free of technical errors.
- Take advantage of the computer's unique capabilities without substituting flash for substance.
- Provide positive reinforcement, and, at the same time, help students to understand wrong answers.
- Include some diagnostic features.
- Be creative, stimulating creativity among its users.
- Allow for easy teacher modifications.
- Provide clearly written support materials and activities.

The National Council of Teachers of Mathematics booklet, "Guidelines for Evaluating Computerized Instructional Materials," offers detailed checklists and provides resource lists for additional information. Also, an "Evaluator's Guide" has been developed by MicroSift, a clearinghouse for microcomputer-based educational courseware and software at the Northwest Regional Educational Laboratory in Portland.

An evaluation of some of the first software to hit the market was done by the Educational Products Information Exchange Institute and the Microcomputer Resource Center at Teachers College, Columbia U. They found that most of the programs are drill and practice, meant to be supplemental and are designed for elementary grades. Most of the software concentrated on arithmetic; there was little in language arts, science or social studies, said Karen Billings, center director. The next phase of the project will examine another group of software, probably new programs in language arts, she said.

At the San Mateo County (California) Educational Resource Center, a unique plan called "softswap" allows teachers to exchange software. Teachers contribute their own software and in return get to use someone else's copyrighted programs.

Choosing Hardware: Before Buying Computers

Education USA/January 4, 1982

Picking out a computer system can be exasperating with the many different types, sizes and costs available.

According to Ed Walsh, manager of the Park Ridge, Ill. educational computer cooperative, choose software first. Claiming selection of a computer should be based 99% on software, Walsh said, "If the software doesn't fit your district's needs, you're either going to have to spend time and money adapting it, or you're going to have to change your district's practices to accommodate it."

Others say the first thing that should be considered when purchasing a computer system is just what the system should accomplish.

Another aspect to watch for, according to John Christensen, who developed the Idaho Falls, Idaho, school district's computer system, is the service contract.

Raymond Carritano, in an article in the September issue of The American School Board Journal, listed 12 steps to explore before purchasing a system:

- Ask colleagues about the models under consideration.
- Take advantage of the sales information that computer companies provide.
- Determine the true cost of a system, including that for upkeep, ease of operation and equipment flexibility.
- Ask if the computer firm offers a lease/purchase option. Many companies allow customers to lease equipment instead of buying it right away.
- Ask whether the firm will guarantee that the model being considered is the company's latest technology. Many times schools are stuck with outmoded models no one will service.
- Determine availability of software suited to the district's needs.
- Request information on operator training courses.
- Determine the amount of day-to-day maintenance required.
- Ask companies if they provide a hotline service or telephone advisory that keeps minor malfunctions and mistakes by operators from becoming major.
- Be sure a company guarantees a reasonable response time and expertise for service calls.

- Inquire about the computer's capacity for expansion.

- Inquire about the after-the-sale enhancement programs whereby new improved technology can be incorporated into previously purchased equipment.

One of the most important steps in selecting computer systems is to make sure that a school district gets what is needed--but nothing more or less. George Van Ness of Peat, Marwick, Mitchell & Co. says, "Don't let vendors show you a school district of 1,000 students with exactly the system you want if your system has 20,000 students because there may be critical differences related to size."

Other aspects of a computer system that should be looked at closely before purchase are types of input and output, ease of operation and programming and quality of instruction manuals.

When deciding on a computer, first analyze funding sources. Although federal funds are short, it may be possible to find some in these programs:

Title I, educationally deprived children; Title II, block grants; Fund for the Improvement of Postsecondary Education; Handicapped Media Services and Captioned Films; Indian education; vocational education; adult education; and the National Institute of Education.

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