DOCUMENT RESUME

ED 262 759 IR 011 837

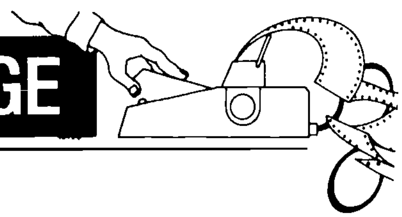
AUTHOR Moursund, David; And Others
TITLE [The Computing Teacher. Selected Articles on Computer Literacy.]
INSTITUTION International Council for Computers in Education, Eugene, Oreg.
PUB DATE 85
NOTE 38p.
AVAILABLE FROM International Council for Computers in Education, University of Oregon, 1787 Agate Street, Eugene, OR 97403.
PUB TYPE Collected Works - General (020) -- Guides - Non-Classroom Use (055) -- Reports - Descriptive (141)
JOURNAL CIT Computing Teacher; Nov 1983, Aug-Nov 1984, Apr-May 1985

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Computer Literacy; Databases; Equal Education; Instructional Material Evaluation; *Microcomputers; Problem Solving; Skill Development; Teacher Education; Teaching Methods
IDENTIFIERS *Computer Uses in Education

ABSTRACT

This document consists of a compilation of nine articles, on computer literacy, that have been extracted from the 1984-1985 issues of the journal "The Computing Teacher". The articles include: (1) "ICLEP (Individual Computer Literacy Education Plan): A Powerful Idea" (David Moursund); (2) "Computers, Kids, and Values" (Stephen J. Taffee); (3) "Educational Software Reviews: Where Are They?" (Steven Brown, George C. Grossman, and Nicola Polson); (4) "Preparing Computer-Using Educators" (Margaret L. Moore); (5) "Making the Computer Neutral" (Jo Shuchat Sanders); (6) "Databasing in the Elementary (and Secondary) Classroom" (Kathy Pon); (7) "A Road Atlas for Computer Literacy and Teacher Training" (William E. Baird); (8) "Problem Solving with Data Bases" (Beverly Hunter); and (9) "Starting from Square 1" (Norma C. Piper). Sources for educational software reviews, including review journals and reports, educational computing journals, educational periodicals, and other sources are listed by Brown, Grossman, and Polson, and computer education guidelines for teacher certification and elementary, secondary, and administrator computer literacy competencies are suggested by Moore. (JB)

EDITOR'S MESSAGE



David Moursund

ICLEP (Individual Computer Literacy Education Plan): A Powerful Idea

I thoroughly enjoyed reading Seymour Papert's book *Mindstorms: Logo, Computers and Powerful Ideas*, describing the general ideas of Logo and its potential impact upon education. Perhaps the most intriguing concept in the book was that of a "powerful idea." Of course, we have all seen powerful ideas before. Democracy is a powerful idea, as is universal literacy. A powerful idea can be understood, accepted and supported by large numbers of people. A really powerful idea, such as a particular form of religion, may change the world. Papert's ideas and Logo may help to change education.

But education is very resistant to change. Thus, it may take quite a few powerful ideas to produce a significant change. I believe that an Individual Computer Literacy Education Plan for educators (and for students as they become educationally more self-sufficient) is a powerful idea that can help change education. The concept is simple enough. Every educator should assume responsibility for his/her own computers-in-education literacy and should consciously develop a plan to acquire a professional level of computer literacy.

Every educator is aware of computers. It is impossible to live in our society without being exposed to computers via movies and television, advertising, actual computers at school and in people's homes, articles in professional journals and magazines, etc. All educators have made conscious or unconscious decisions about how they will deal with computers—about how computers will be involved with their professional and non-professional lives.

Often an educator's "computer decision" is based upon relatively little factual knowledge and upon facts that change rapidly with time. An educator may have had exposure to a computer while in college many years ago. That first impression lingers and perhaps dominates, even though it is only vaguely related to today's inexpensive, interactive, graphics-oriented microcomputer system. An educator may have had a computer course, poorly taught and not particularly appropriate to the educator's needs. This may have left a lasting impression that computers are a difficult topic, certainly beyond the capabilities of most young students.

Alternatively, an educator may have been exposed to a "dream world" such as an elementary classroom full of microcomputers and Logo disks, with students taught by an exceptionally capable teacher with a deep knowledge of Logo and discovery-based learning. The educator may be aware of word processing and equate this with all students learning to write both well and often. The educator may be aware that computers can solve equations and graph functions—this may be equated with a complete revision of the mathematics curriculum. The educator may be aware of electronic spreadsheet programs and equate this with a complete revision of the accounting curriculum.

In either case, educators need a modern, realistic awareness of the current and potential capabilities of computers as well as their limitations. Such an awareness can be gained through a modest amount of reading, hands-on experience, talking to people and thinking about computers. It might come from attendance at a computer conference or participation in a computer workshop.

What comes next? An ICLEP—an Individual Computer Literacy Education Plan. Each educator has a substantial professional level of knowledge and skills in education. But the nature of the knowledge and skills varies tremendously among educators. The elementary school teacher has little need for the subject matter specialty knowledge of the secondary school physics teacher or the administrative skills of the district superintendent. Clearly, each educator has need for computer literacy knowledge and skills suited to his or her own role in education.

Who is best suited to determine the individual computer literacy levels of knowledge and skills needed by various educators? To a very large extent it is the educators themselves! Certainly outside help is desirable, especially in gaining initial computer awareness. But who am I to try to tell elementary school music or art specialists what they need to know about computers to do their job in a professional manner? Who am I to try to tell a school principal, a health teacher, a social studies teacher and an industrial arts teacher what they need to know to continue to be professionals in their respective areas of education?

The key to this is professionalism. Most educators look upon themselves as professionals—highly trained and skilled in performing their jobs. They have confidence in their knowledge and skills, as well as in their ability to gain additional knowledge and skills.

Each educator needs to be encouraged to consciously develop an ICLEP. An educator's ICLEP consists of two main parts. The first part is a plan for gaining general computer literacy such as one might expect of all educators. Such a plan should take into consideration that educators are college-educated and serve as role models to their students.

The second part of an ICLEP should be specific to the educator's particular professional responsibilities. This may need to change quite rapidly as computers become readily available to students and they develop skill in their use.

An ICLEP includes both short- and long-term goals. It includes specific objectives and ways to measure progress toward these objectives. It includes timelines and check points, specific times or points where progress is reviewed, goals and objectives are considered and new goals and objectives are set.

An ICLEP is well suited to educators, since educators are well educated, professional level adults. But what about students? Certainly it is not reasonable to expect a first grade student to accept prime responsibility for developing an ICLEP. But how much responsibility might a ninth grader take? As a student progresses through our educational system, it is reasonable that the student assume more and more individual responsibility for his/her education. One major goal of the educational system should be to help students acquire the maturity and wisdom to accept and deal with this responsibility.

Computer literacy is an excellent area in which to give students an opportunity to assume and practice this individual responsibility. This is especially true because the opportunities for acquiring a high and functional level of computer literacy are by no means fully institutionalized. Students can and do learn a great deal about computers at home, at friends' homes, at science museums and libraries, etc.

Your role as an educator should be clear. Not only should you have your own ICLEP, but you should help students develop their own ICLEPs. Even in the first grade, students can begin to accept responsibility for their own education. Our formal, in-school educational system is only part of a student's opportunity to learn. Early and frequent encouragement should be given to all students to make education an all-day, everyday, lifetime experience.

END■

Computers, Kids and Values

by
Stephen J. Taffee

Introduction

The computer revolution has brought with it a host of related ethical and moral concerns which have been given little more than lip service by educators. These concerns include privacy issues, equality of computing opportunity, violence and stereotyping of characters in computer games and computer crime. There are reports of students becoming engrossed in computers at the expense of their relationships with others and/or their school work. Educators wanting to address these concerns find their efforts confounded by a lack of legal certainty about hardware and software copyrights and patents; the availability of sophisticated copy programs and hardware designed to reproduce even copy-protected software; software rental agencies (which allegedly contribute to illegal copying); the hero image accorded computer "hackers" (a la *War Games*) who make unauthorized entry into computer systems; and a great deal of confusion and conflict in society at large about the appropriate place for computers in our daily lives.

While answers to what is "right" or "wrong," "good" or "bad" about computers may be elusive, a means for making such judgments is not. Educators have been using values clarification for many years to help students acquire more meaningful, socially constructive guides to decision making. While this process and technique is widely known (Raths, Simon and Harmin, 1978; Simon, Howe and Kirschenbaum, 1972; Simon and Clark, 1975), values clarification has seldom been applied to computer-related issues.

Values Clarification

Values clarification is a process for helping students make better informed decisions about values and moral issues. It is neither morally absolute nor morally relativistic ("everything goes"). Instead, it requires that students reflect on available value choices, the consequences of each choice, how they act on their values and how they feel about their values. Students are encouraged to develop the interpersonal communications skills necessary to explore such issues with each other in meaningful ways. Teachers, through the use of carefully constructed values clarification exercises and class discussion, can help students wrestle with many important issues involving computers, without lecturing and nagging on the one hand, or simply avoiding the subject, hoping students will somehow work it out on their own.

Here are several values clarification strategies which focus upon values and moral issues concerning computers or which use computer terms as a means of stimulating discussion of broader issues. Remember—each strategy is meant as a stimulus for discussion and is not an end in itself. Clarification of values occurs when students have an opportunity to reflect and to share their thoughts and feelings over a period of time. Teachers must guard against their own as well as students' moralizing and try to keep the class free from pronouncements of right and wrong which can end class participation prematurely.

The new user of values clarification strategies is strongly encouraged to read one of the many introductions to the use of the technique which are available (see References). While the techniques are not difficult to use, it is important that they be used in a manner which will reduce the tendency to moralize or otherwise influence students to respond in ways which they believe would be acceptable to their teacher. Teachers are encouraged to share their own responses to any of these strategies with their students, but it is best done toward the end of class so as not to unduly influence students.

Strategies About Computers

Strategy #1—Values Continuum

One of the mainstays of values clarification, the values continuum, encourages students to see that values often are not absolute, and that there can be a wide range of opinions on a given topic.

Directions: Explain the extremes represented by each end of the continuas in figures 1 and 2, and ask students to consider where their values fall on those continua. The strategy may be processed using any of the outlined discussion techniques.

In figure 1, "Lock-It Louise" believes that all software should be extensively copy-protected and that violators should be prosecuted to the full extent of the law. Copy programs and devices, and software rental enterprises would be outlawed. "Copy-Kate," on the other hand, would do away with all copy-protection schemes, and would support legislation to allow all software to be listed and modified as the user sees fit. In the meantime, the copying of software is seen as a perfectly legitimate alternative.

In figure 2, Gaming Gabe is a computer game freak who defines computers as "toys" and is only interested in using computers for fun. Serious Cyril sees computers as "tools" and takes a work-oriented approach to them. Cyril is interested in computers to the extent that they can make his life more productive and profitable.

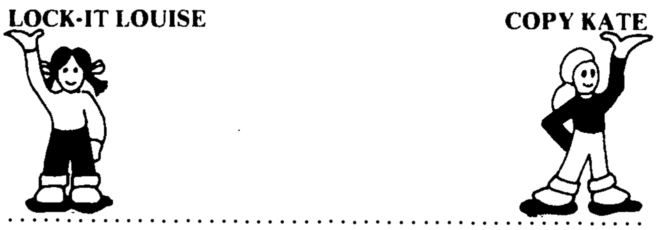


Figure 1.
Software protection continuum.

Figure 2.
Purpose of computers continuum.

Discussion: The continuum strategy may be processed in several ways.

1. Designate ends of the classroom as ends of the continuum and ask students to walk to the part of the room which best represents their position on the continuum. Once there, they may discuss their choices and reasoning with nearby students and adjust their position if necessary.
2. You can draw a continuum on a chalkboard or overhead transparency and ask several students to write their name on the continuum at the spot representing their position. A class discussion can follow.
3. You may keep this activity (and any of those which follow) at a more "private" level and encourage students to interact with each other in small groups or to write about their experiences in a journal.

Strategy #2—Rank Order

In this strategy, students are asked to prioritize a list of alternatives. The choices may be constructed to be mostly attractive or unattractive (thus making choosing more difficult), or neutral to encourage a range of opinion.

Directions: Explain to students that they are to rank order the following classes of programs. (Some may need to have the meaning of rank order explained to them.) Students are to place the number 1 next to the type of program most important to them, a 2 next to the next most important, and so on.

______ Arcade-type games
______ Communications utilities
______ Copy utilities
______ Educational games/drills/tutorials
______ Fantasy games
______ Graphics/drawing (including Logo)
______ Programming utilities
______ Spreadsheets
______ Word processing

Discussion: The activity may be processed by asking students to share their rank orders with the rest of the class or a small group. Students may also make private journal entries.

Rank orders may also be applied to situations involving people. For example, teachers could read the following anecdote to their class, and ask students to rank order the characters' behavior from most ethical to least ethical:

> Mary recently was given a new computer system for her birthday. Prior to that, she was very interested in computers, but mostly because her friend, Brad, was president of the school's computer club. Mary would like to join the school's club, both to learn more about her computer and to be closer to Brad. However, the club has an unofficial initiation requirement that one "pirated" program be submitted to the club's software library by every new member. Brad tells Mary that if she wants to join, she needs to provide the group with a copy of *Martian Mania* (a copy-protected game that came with her new computer). Mary refuses, telling Brad that to do so would be wrong, and even if she wanted to she wouldn't know how to copy it. Another club member, Ann, tells Mary that she could borrow any one of her nibble copying programs or even use her "duplicard"—a hardware device for copying protected software. Disgusted with both Brad and Ann, Mary secretly lets the club's advisor know about the pirating and illegal software library. The advisor subsequently disciplines Brad and Ann, and erases all the club's illegal programs.

Rank the behaviors of the following persons or groups from most ethical to least ethical:

Ann
Brad
Club Advisor
Duplicard, Inc. (manufacturers of software and hardware copying devices)
Martian Mania's producers
Mary

A discussion—quite likely a lively one—can follow. Be sure to insist that students respect each other's right to an opinion and try to keep the discussion focused on what the characters did or should have done. You can also ask students to consider the ethics of the situation from a perspective other than their own, e.g., the school, the publisher of copy-protected software, the makers of copy-protection breaking devices or a judge.

Strategy #3—Either/Or

This strategy forces students to consider how they perceive the computer, often with very interesting and insightful reasoning. (See Strategy #8 for an example of either/or statements which ask students to make judgments on a more personal level.)

Directions: Ask students to respond to the following statements. Discussion may follow the techniques suggested in Strategy #2—Rank Order.

Which is a computer more like?
—Friend or foe?
—Hard or soft?
—Threat or savior?
—Male or female?
—Pleasure or pain?
—Puzzle or solution?
—Work or hobby?
—Person or machine?
—Fire or ice?
—Tool or resource?
—Monster or Messiah?

Strategy #4—Values Sheets

Values sheets are among the most adaptable and available of the values clarification strategies. They are reasonably easy to construct and may be processed in a variety of ways.

Directions: Provide students with a short quotation, portion of a magazine or newspaper article, a picture, cartoon or similar "stimulus." They are then to respond to a series of carefully constructed questions which you have prepared. For example, you might distribute the following, well-known quotation from Evans (1979):

> Suppose for a moment that the automobile industry had developed at the same rate as computers. . . . Today you would be able to buy a Rolls-Royce for $2.75, it would do three million miles to the gallon, and it would deliver enough power to drive the Queen Elizabeth II. And if you were interested in miniaturization, you could place half a dozen of them on the head of a pin. (p. 76)

1. What three words best describe your reaction to this quotation?

2. What would the world be like if progress in automobiles had indeed matched that of the computer industry?
3. What progress would you like to see in computers during the next twenty years?
4. If you had been given a choice twenty years ago between being able to produce a Rolls Royce quality car for $3.00 or an advanced computer, which would you have chosen? What would have been the consequences of your choice?
5. How is your life different because of microcomputers?

The following cartoon could also be used as a discussion starter:

© 1981, The Philadelphia Inquirer/Washington Post Writers Group. Reprinted with permission.

Potential processing questions might include:

1. What do you think is meant by the term "brain/reality coordination"? What concern is the speaker revealing by this statement?
2. Which would you rather do with a computer: write a letter, solve a problem or play a game? How might you modify the quality and amount of time you spend using a computer?
3. What kind of computer game would you rather play? Pick one quality from each column:

DIFFICULTY	OUTCOME
☐ Computer wins more than 50% of the time.	☐ Enemy (or you) destroyed.
☐ You win more than 50% of the time.	☐ Treasure gained (or lost).

DISPLAY	INPUT DEVICE
☐ Lots of animation & color	☐ Joystick or paddles
☐ Lots of text	☐ Keyboard

4. Which would you rather do (or be able to do)?
   - ☐ Play a computer game.
   - ☐ Write (program) a computer game.
   - ☐ Be a character in a computer game (like *Tron*).
   - ☐ Watch an expert play a computer game.

Strategy #5—Inventory

Computers and technology enter our lives in hundreds of ways almost every day. Many of us use the world's largest computer network every day (the telephone system) without even thinking of it as computer-driven. Similarly, we receive mail generated by computer mailing lists and buy groceries which are classified and priced by a computer.

Directions: Students are to keep a journal of the number and type of computers and technologically-related devices (e.g. calculators) which they encounter in one week. The activity may be processed individually, in small groups or by the whole class.

Strategy #6—Unfinished Sentences

Like the values sheet, this activity can be spontaneously constructed by a teacher, or suggestions can be elicited from the students themselves. It is an excellent warm-up activity for more in-depth activities, and can remain viable indefinitely if the sentence stems are varied and the strategy itself not overused.

Directions: Students are to complete the following sentence stems. Process the activity through techniques previously identified.

- I wish computers were more _______ and less _______.
- Computers are _______.
- I'd rather work with a computer than _______, but I'd rather _______ than work with a computer.
- Copying programs _______.
- "Hackers" _______.
- The best thing I've ever done on a computer was _______.
- Computers are never _______ but they're always _______.
- Ten years from now, I hope computers _______.

Strategies Which Use Computers

As students become more computer literate, educators will be able to use computers as examples and symbols for other aspects of life. Strategies 7 and 8 make use of the computer as a means of stimulating discussion about a range of values-related issues.

Strategy #7—Ask the Computer

Directions: Tell students that they have been given a rare opportunity to ask questions of the world's largest, fastest and smartest computer. However, they will each be allowed to ask only one question. While the computer is the world's smartest, it is limited and may not be able to answer "impossible" questions such as, "How many stars are in the universe?" Care should be taken, therefore, to construct a question which is both reasonable and personally meaningful to the student.

Students can be encouraged to work alone or in groups. If you wish, you might ask students to write an essay about their question and how it is important to them. Questions can be shared, with a class discussion held on the types of questions asked and which ones a computer could really answer.

This strategy could easily work into an extended discussion pertinent to computer literacy. You might discuss which is more important: asking good questions, providing good answers or having good information. This would provide an excellent opportunity to discuss the limitations of computers and whether "logical" answers are always "right" answers.

Strategy #8—Either/Or

Which are you more like?

—Dot-matrix printer or a letter-quality printer?
—Timex/Sinclair or a Cray supercomputer?
—Floppy disk or a hard disk?
—RAM or ROM?
—Input or output?
—Bit or a byte?
—Hardware or software?
—BASIC or assembly language?

General Comments and Conclusion

Our knowledge and skills in working with computers are progressing at breathtaking speed. If computers are to become fully integrated into our lives and our society, then concerted efforts must be made to encourage progress concerning the many value-related concerns accompanying the computer revolution. Computers are inherently apolitical, unbiased and unthinking machines, yet they may be used in ways which dehumanize and oppress people, or in ways which personalize and liberate people. Values clarification offers us a mechanism for beginning a dialogue with students about such issues. Like the computer itself, it is not a panacea, but it is an exceptional opportunity and resource. **END■**

[Stephen J. Taffee, Associate Professor of Education, North Dakota State University, Fargo, ND 58105.]

[This article will also appear in a forthcoming book, edited by the author, entitled Annual Editions: Computers in Education 84/85. *Dushkin Publishing Group, Inc.]*

References

Evans, Christopher. *The Micro Millenium.* New York: Viking Press, 1979.

Raths, Louis, Merrill Harmin and Sidney B. Simon. *Values and Teaching, Working with Values in the Classroom.* 2nd edition. Columbus, OH: Charles E. Merrill Publishing Company, 1978.

Simon, Sidney B. and Clark, Jay. *Beginning Values Clarification.* San Diego, CA: Pennant Press, 1975.

Simon, Sidney B., Howe, Leland W. and Kirschenbaum, Howard. *Values Clarification: A Handbook of Practical Strategies for Teachers and Students.* New York: Hart Publishing Company, 1972.

Educational Software Reviews: Where Are They?

by
Steven Brown, George C. Grossman and Nicola Polson

In the February 1982 issue of *The Computing Teacher*, Ann Lathrop listed journals that carried educational software reviews and described the type of reviews offered by each.[1] Her article was particularly for teachers who did not have the benefit of previewing a lot of software, which put them in the uncomfortable position of having to order expensive software based on the description in a publisher's catalog or on a product announcement.

Choosing software has not become any easier in the last two years. The number of software publishers is now in the hundreds and increasing steadily. Many provide catalogs listing their products, but the catalogs rarely provide enough information for the prospective user to make an intelligent purchase decision. Many publishers refuse to send "on approval" orders or provide review copies. The only reasonable alternative for many educators is to seek critical reviews published in professional and popular journals.

To help educators find such reviews, a follow-up of Lathrop's study was conducted to identify current sources of software reviews and to describe the type of review offered by each. Over 350 publications were surveyed. In spite of this, the list compiled is not all-inclusive. An increasing number of subject-specific education journals carry software reviews. There are also many general-purpose and brand-specific computer magazines and newsletters which carry reviews, some of which may be applicable to education.

SOURCES OF EDUCATIONAL SOFTWARE REVIEWS

Review journals and reports are published by commercial or non-profit organizations for the specific purpose of disseminating information about educational materials. Many review all types of media such as books, films, tapes and kits, while others limit their reviews to educational computer software. Reviews in these journals normally cover many subjects and all grade levels.

Educational computing periodicals focus specifically on educational uses of computers in schools. Reviews in these journals typically cover the entire spectrum of educational software.

Education periodicals include both general education publications and those dealing with educational specialties and specific subject areas. A rapidly increasing number of general education journals publish software reviews. Media-oriented journals often publish a wide variety of reviews, and subject area journals provide good sources of reviews in specific disciplines.

Educational computing newsletters are prepared periodically by or for educators with common interests or within a geographical area.

Other sources of information. This category contains important sources of information which do not fit easily into any of the above categories. These include directories of information on software, sources of reviews that are not in a bound format, and listings of favorably reviewed educational software.

In reading a review it helps to know the name, background and prejudices of the reviewer. The reviews in each publication reflect what the editor, editorial board or reviewer thinks are the most important aspects of educational software. Reviews vary in the number of categories of evaluation, the amount of description, the format for presenting evaluation summaries, and the relative emphasis on selected features of the software. Some focus mainly on the design and the attractiveness of the graphics, while others downplay that aspect and focus more on educational soundness. Computer-oriented journals are more likely to focus on the technical aspects of a program while educational journals often emphasize pedagogical considerations. Because the information contained in software reviews differs greatly from source to source, it is wise, whenever possible, to read several reviews of the same product prior to making a purchase decision.

Each review provides a glimpse of a specific software product. Although it may not be possible to tell for sure from a review whether a particuiar software package is what you want, it is possible to eliminate many that do not seem appropriate for your particular objectives. This alone takes much of the guesswork out of software selection.

DEFINITION OF TERMS

The following terms are used to describe the types of reviews. There is overlap in many cases, and some that do not fit easily into this format. The terms are meant only as a guide.

Descriptive reviews give details about a program without making any judgments.

Critical reviews express judgments of merits and faults. They are usually one person's opinion.

Evaluative reviews assign a value to the program using some type of scale. Evaluative reviews are often done by a team of reviewers.

Review Journals and Reports

THE APPLE JOURNAL OF COURSEWARE REVIEW, ISSUE 1
(formerly *The Journal of Courseware Review*, Vol. 1 #1)
Review Type: Critical
Reviewer: Educators and instructional designers; signed.
Average Number of Reviews Per Issue: 15
Average Length of Review: 4 pages
Comments: Includes screen shots and cataloging information.
Price: Suggested retail price: $5.95 per issue. Available through local Apple dealers.

DIGEST OF SOFTWARE REVIEWS: EDUCATION
Review Type: Abstracts of other reviews
Average Number of Reviews Per Issue: 50
Average Length of Review: 1-2 pages
Comments: Abstracts reviews from over 80 educational computer journals, education journals and computer magazines.
Price: $53 for 4 issues/yr. *Digest of Software Reviews: Education*, 301 West Mesa, Fresno, CA 93704.

EVALUATIONS: MICROWARE
Review Type: Evaluative.
Reviewer: Teachers
Average Number of Reviews Per Issue: 25
Average Length of Review: 1 page
Comments: 1-3 rating on content, instructional quality and technical quality.
Price: Unknown. *Evaluations: Microware,* 7351 Elmbridge Way, Richmond, B.C., Canada V6X 1B8.

HIVELY'S CHOICE
Review Type: Descriptive
Reviewer: Staff (educators, consultants)
Average Number of Reviews Per Issue: 106
Average Length of Review: 2 pages
Comments: Annual book. All software included is recommended by educators. Aimed at preschool-grade 9. "Classroom Uses" an important part of each review.
Price: $19.95 (1983-84 issue). *Hively's Choice,* 520 E. Bainbridge St., Elizabethtown, PA 17022-9989.

LIBRARY SOFTWARE REVIEW
(formerly *Software Review*)
Review Type: Extensive critical
Reviewer: Signed
Average Number of Reviews Per Issue: Varies
Average Length of Review: 4-6 pages
Comments: Was quarterly. "Becoming more frequent in 1984."
Price: $58 for 4 issues/yr. *Library Software Review,* 520 Riverside Ave., Westport, CT 06880.

MicroSIFT REVIEWS
Review Type: Evaluative
Reviewer: Teachers (several per software package)
Average Number of Reviews Per Issue: 100 per year. Distributed 4 times a year.
Average Length of Review: 1-2 pages
Comments: Distributed through *The Computing Teacher* and other periodicals, RICE database, ERIC and through a nationwide network of educational service agencies. Matrix and rating scale included.
Available From: *MicroSIFT Reviews,* 300 S.W. Sixth Ave., Portland, OR 97204.

PERSONAL SOFTWARE
Review Type: Critical
Reviewer: Staff
Average Number of Reviews Per Issue: Varies
Average Length of Reviews: 1 page
Price: $24 for 12 issues/yr. *Personal Software,* Box 2919, Boulder, CO 80322.

SECTOR (SPECIAL EDUCATION COMPUTER TECHNOLOGY ONLINE RESOURCES) PROJECT
Review Type: Critical
Reviewer: Staff
Average Number of Reviews Per Issue: 58
Average Length of Review: 2 pages
Comments: Two packets available: (1) Courseware Evaluation Material, which includes courseware evaluation form, documentation and a project overview; and (2) Special Applications for Special Educators.
Price: $15 each. *SECTOR Project,* Exceptional Child Center, UMC-68, Utah State University, Logan, UT 84322.

SOFTWARE REPORTS
Review Type: Evaluative
Reviewer: Teachers, parents, students
Average Number of Reviews Per Issue: 382 pages of reviews annually.
Average Length of Review: 1 page
Comments: Well-organized, complete, cross-referenced directory/buying guide. Includes subject reference chart for a quick search of available software.
Price: $60 per issue. *Software Reports,* 2101 Las Palmas Dr., Carlsbad, CA 92008.

Educational Computing Periodicals

ACCESS: MICROCOMPUTERS IN LIBRARIES
Review Type: Critical
Reviewer: Signed. Reviews usually done by librarians/media specialists.
Average Number of Reviews Per Issue: At least one signed review.
Average Length of Review: 1 page
Comments: One issue reprinted evaluative reviews from MicroSIFT. Signed reviews usually library-oriented.
Price: $11 for 4 issues/yr. *ACCESS: Microcomputers in Libraries,* Box 764, Oakridge, OR 97463.

AEDS MONITOR
Review Type: Critical
Reviewer: Signed
Average Number of Reviews Per Issue: 0-2
Average Length of Review: 1 page
Comments: Most issues do not have reviews. Reviews reprinted from another source.
Price: $22 for 6 issues/yr. AEDS Monitor, 1201 Sixteenth St. N.W., Washington, D.C. 20036.

THE CALICO JOURNAL
Review Type: Descriptive with critical comments
Reviewer: Educators; signed.
Average Number of Reviews Per Issue: 0-1
Average Length of Review: 1/4 to 1 page
Comments: A new journal dealing with computer-aided language arts instruction. Software review section is to be expanded.
Price: $25 for 4 issues/yr. *The CALICO Journal,* 229 KMB, Brigham Young University, Provo, UT 84602.

CLASSROOM COMPUTER LEARNING
Review Type: Critical
Reviewer: Staff and professionals; signed.
Average Number of Reviews Per Issue: 4
Average Length of Review: 1/2 page
Price: $19.95 for 9 issues/yr. *Classroom Computer Learning,* 19 Davis Drive, Belmont, CA 94002.

COMPUTERS, READING AND LANGUAGE ARTS (CRLA)
Review Type: Evaluative
Reviewer: Educators
Average Number of Reviews Per Issue: 8
Average Length of Review: 1½ pages
Price: $14 for 4 issues/yr. *CRLA,* P.O. Box 13247, Oakland, CA 94661.

THE COMPUTING TEACHER
Review Type: Critical
Reviewer: Signed with background
Average Number of Reviews Per Issue: 5
Average Length of Review: 1 page
Comments: Publishers' replies frequently accompany the reviews. MicroSIFT reviews sometimes included.
Price: $21.50 for 9 issues/yr. *TCT*, University of Oregon, 1787 Agate St., Eugene, OR 97403-1923.

EDUCATIONAL TECHNOLOGY
Review Type: Critical comments
Reviewer: Signed; educators
Average Number of Reviews Per Issue: 4
Average Length of Review: 1-2 pages
Comments: All reviews based on field testing.
Price: $49 for 12 issues/yr. *Educational Technology*, 140 Sylvan Ave., Englewood Cliffs, NJ 07632.

ELECTRONIC EDUCATION
Review Type: Descriptive
Reviewer: "Hively's Choice"
Average Number of Reviews Per Issue: 1
Average Length of Review: 2 pages
Comments: Programs reviewed are all recommended by reviewer.
Price: $18 for 8 issues/yr. 1311 Executive Center Dr., Suite 220, Tallahassee, FL 32301.

ELECTRONIC LEARNING
Review Type: Descriptive with critical comments
Reviewer: Team of educators
Average Number of Reviews Per Issue: 4-6
Average Length of Review: 1 page
Comments: Screen shots included.
Price: $19 for 8 issues/yr. *Electronic Learning*, 730 Broadway, New York, NY 10003-9538.

JOURNAL OF COMPUTERS IN MATHEMATICS AND SCIENCE TEACHING
Review Type: Brief description
Reviewer: Staff
Average Number of Reviews Per Issue: 10
Average Length of Review: Very short paragraph
Comments: In each issue, software of a particular type or on a particular topic is also listed.
Price: $15 for 4 issues/yr. *Journal of Computers in Math and Science Teaching*, Box 4455, Austin, TX 78765.

MATHEMATICS AND COMPUTER EDUCATION
Review Type: Critical comments
Reviewer: University faculty; signed
Average Number of Reviews Per Issue: 3-6
Average Length of Review: ½-3 pages
Comments: Formerly *MATYC Journal*
Price: $13.50 for 3 issues/yr. *Mathematics and Computer Education*, Old Bethpage Rd., Long Island, NY 11804.

TEACHING AND COMPUTERS
Review Type: Descriptive
Reviewer: Educators
Average Number of Reviews Per Issue: 7
Average Length of Review: 1/3 page
Comments: Educators write short descriptions of software they recommend.
Price: $19 for 8 issues/yr. *Teaching and Computers*, 902 Sylvan Ave., Englewood Cliffs, NJ 07632.

T.H.E. (TECHNOLOGICAL HORIZONS IN EDUCATION) JOURNAL
Review Type: Descriptive
Reviewer: Unknown
Average Number of Reviews Per Issue: 30
Average Length of Review: 1/6 page
Price: $15 for 8 issues/yr. *T.H.E. Journal*, P.O. Box 17239, Irvine, CA 92713.

Education Periodicals

ARITHMETIC TEACHER
Review Type: Critical comments
Reviewer: Educators; signed
Average Number of Reviews Per Issue: 3
Average Length of Review: 1/2 page
Comments: Not all issues have reviews. Reviews only math programs.
Price: $30 for 9 issues/yr. *Arithmetic Teacher*, 1906 Association Dr., Reston, VA 22091.

BOOKLIST
Review Type: Critical
Reviewer: Selected reviewers experienced in use and evaluation of software.
Average Number of Reviews Per Issue: 20
Average Length of Review: 1/4 page
Comments: Not all issues have reviews. Prints reviews only for titles recommended for purchase.
Price: $40 for 22 issues/yr. *Booklist*, 50 East Huron St., Chicago, IL 60611.

CURRICULUM REVIEW
Review Type: Descriptive with critical comments
Reviewer: Educators; signed
Average Number of Reviews Per Issue: 10
Average Length of Review: ½-1 page
Price: $35 for 5 issues/yr. *Curriculum Review*, 517 S. Jefferson St., Chicago, IL 60607.

INSTRUCTOR
Review Type: Descriptive
Reviewer: Teachers
Average Number of Reviews Per Issue: 0-2
Average Length of Review: 1/6 page
Comments: One issue had 25 reviews.
Price: $18 for 9 issues/yr. *Instructor*, 757 Third Ave., New York, NY 10017.

JOURNAL OF LEARNING DISABILITIES
Review Type: Evaluative
Reviewer: Educators
Average Number of Reviews Per Issue: 2
Average Length of Review: 2 pages
Comments: A single report by a staff member is assimilated from separate reports from 2-5 field reviewers.
Price: $32 for 10 issues/yr. *Journal of Learning Disabilities*, 11 E. Adams St., Chicago, IL 60603.

MATHEMATICS TEACHER
Review Type: Critical
Reviewer: Educators; signed
Average Number of Reviews Per Issue: 7
Average Length of Review: 1/2 page
Comments: Some programs are reviewed separately by two reviewers.
Price: $30 for 9 issues/yr. *Mathematics Teacher,* 1906 Association Dr., Reston, VA 22091.

MEDIA AND METHODS
Review Type: Critical
Reviewer: Staff
Average Number of Reviews Per Issue: 2
Average Length of Review: 1/2 page
Price: $24 or 9 issues/yr. *Media and Methods,* 1511 Walnut St., Philadelphia, PA 19102.

PHYSICS TEACHER
Review Type: Evaluative
Reviewer: Educators
Average Number of Reviews Per Issue: 1
Average Length of Review: 1 page
Comments: Rating scale included.
Price: $42 for 9 issues/yr. *Physics Teacher,* Graduate Physics Bldg., SUNY, Stony Brook, NY 11794.

SCHOOL SCIENCE AND MATHEMATICS
Review Type: Description with some critical comments
Reviewer: Signed
Average Number of Reviews Per Issue: 2
Average Length of Review: 2 pages
Price: $22 institution, $19 individual for 8 issues/yr. *School Science and Mathematics,* Bowling Green State University, 126 Life Science Bldg., Bowling Green, OH 43403.

Educational Computing Newsletters

CHIME (CLEARINGHOUSE OF INFORMATION ON MICROCOMPUTERS IN EDUCATION)
Review Type: Evaluative
Reviewer: Teachers; signed
Average Number of Reviews Per Issue: 10
Average Length of Review: 1/2 page
Comments: Rating scale included
Price: $15 for 6 issues/yr. *CHIME,* 108 Gunderson, Oklahoma State University, Stillwater, OK 74078.

CLOSING THE GAP
Review Type: Descriptive
Reviewer: Staff
Average Number of Reviews Per Issue: 2
Average Length of Review: 1 page
Comments: Aimed at teaching the handicapped. Discusses specialized hardware, software.
Price: $15 for 6 issues/yr. *Closing the Gap,* P.O. Box 68, Henderson, MN 56044.

CUE—COMPUTER-USING EDUCATORS
Review Type: Descriptive with critical comments
Reviewer: Educators; signed
Average Number of Reviews Per Issue: 3-4
Average Length of Review: 1/2 page
Comments: Educators who write reviews field test the programs.
Price: $8 for 8 issues/yr. *CUE,* 127 O'Connor St., Menlo Park, CA 94025.

EDUBUS
Review Type: Critical
Reviewer: Signed, background not given
Average Number of Reviews Per Issue: 2-4
Average Length of Review: 2-4 pages
Price: $10 for 5 issues/yr. *EDUBUS,* 2500 University Dr., Calgary, Alberta, Canada T2N 1N4.

HANDS ON!
Review Type: Critical
Reviewer: Signed
Average Number of Reviews Per Issue: 1
Average Length of Review: 2 pages
Price: $10 for 4 issues/yr. *Hands On!,* 8 Eliot St., Cambridge, MA 02138.

MICROCOMPUTER DIGEST
Review Type: Descriptive
Reviewer: Unknown
Average Number of Reviews Per Issue: 1
Average Length of Review: 1/2 page
Price: $29.95 for 11 issues/yr. *Microcomputer Digest,* C.E.O. Associates, 201 Route 516, Old Bridge, NJ 08857.

MICROCOMPUTERS IN EDUCATION
Review Type: Critical
Reviewer: Usually staff, signed
Average Number of Reviews Per Issue: 6
Average Length of Review: 1/2 page
Comments: Includes summaries of reviews from other sources.
Price: $33 for 12 issues/yr. *Microcomputers in Education,* 5 Chapel Hill Dr., Fairfield, CT 06432.

USERS: THE MECC INSTRUCTIONAL COMPUTING NEWSLETTER
Review Type: Critical
Reviewer: Staff
Average Number of Reviews Per Issue: 1-2
Average Length of Review: 1 page
Comments: Concentrates on MECC software.
Price: Sent on request. *USERS,* MECC, 3490 Lexington North, St. Paul, MN 55112.

Other Sources of Information

THE 1984 EDUCATIONAL SOFTWARE PREVIEW GUIDE
A list of 500 favorably reviewed instructional software programs for K-12 use. Developed by the Educational Software Evaluation Consortium, representing 27 organizations involved in computer education throughout North America. The guide is designed to assist educators in locating software for preview. Selection based on critical evaluations conducted by participating organizations and on reviews published in other journals.
Price: $5.00. ICCE, University of Oregon, 1787 Agate St., Eugene, OR 97403-1923.

EPIE (Educational Products Information Exchange) has two products available related to software evaluation and selection:

PRO/FILES
Initially contains a box with a minimum of 250 in-depth evaluations, with a minimum of 40 updates every two months. Each evaluation, done by EPIE's nationwide network of evaluators, is 4-6 pages and includes an overall rating, screen shots, student comments and teacher use.
Price: $180.

THE EDUCATIONAL SOFTWARE SELECTOR (TESS)

A directory and evaluation guide containing detailed information on over 5,000 pieces of educational software. Contains references to EPIE evaluations, gives review ratings and refers to reviews in 14 other sources. Each entry approximately 200 words. Available electronically spring 1984.

Price: $49.00.

EPIE Institute, P.O. Box 839, Water Mill, NY 11976.

END

[Steven Brown is currently in the master's program for Computers in Education at the University of Oregon. He had 12 years teaching and administrative experience, including 10 years in overseas American schools in Norway, Holland and Singapore.

George C. Grossman, Associate Professor of Education, Central Washington University, Ellensberg, WA 98926.

Nicola Polson spent three years as a chemist and six years teaching in British Columbia. Currently enrolled in the master's program in Computers in Education at the University of Oregon.]

Preparing Computer-Using Educators

by
Margaret L. Moore

Question: What training is needed to prepare computer-using educators?

Answer: What do you mean by "computer-using educators"?

This question-answer dialogue indicates some of the issues currently confronting teacher education programs, teacher certification agencies, teacher councils/organizations, school district inservice organizers and many other groups involved in education's response to computer technology. Questions evoke other questions instead of answers.

The Northwest Council for Computer Education (NCCE) funded a project to develop a set of guideline competencies to aid in the development of teacher training programs. The rationale for the development of these guideline competencies was:

1. To provide a set of competencies to help guide teacher inservice and preservice programs (both college/university and school district);
2. To provide a set of competencies to aid in assessing and re-evaluating teacher certification requirements (both college/university and state agencies charged with certification responsibilities);
3. To provide a forum for the discussion of the needs of computer-using educators (helping to educate educators about issues, definitions, problems); and
4. To encourage further development of competencies by providing a starting place for other evaluation groups.

A five-stage model was used for the development of the competencies:

- Review (or information gathering)
- Identification and definition of issues
- Formulation of competencies
- Evaluation of competencies
- Dissemination and results

REVIEW

The review process provided important background information. A 1982 NCCE survey of Oregon and Washington showed that elective courses dealing with computers were available in colleges and schools of education. Neither state required teacher certification in computer science. Information from the survey indicated that course and curricular offerings were heavily dependent on the training and expertise of the faculty at individual institutions. A review of college/university programs throughout the United States indicated a similar diversity in programs and courses. Single course offerings were apparently directed toward general use of computers in education rather than toward teaching computer science. Most of the institutions did not *require* those courses and most were offered in summer sessions (indicating programs designed to help educators "catch up" with technological advancements).

A national review by Taylor and Poirot (1983) indicated that only four states—Arizona, Illinois, Texas and Wisconsin—offered separate computer science certification for teachers. Thirteen other states indicated that certification was offered as part of another discipline. Typically, the joint offering was with mathematics. Information from this survey indicated wide variances in certification requirements among those states offering certification. The survey also indicated that certification requirements were hampered by the ability of college/university programs to provide the courses to meet those requirements.

IDENTIFICATION AND DEFINITION OF ISSUES

Throughout the review stage, information was gathered on issues to be considered in any discussion of the needs of computer-using educators. Three areas of concern became apparent: general education, computer education and computer science education.

General Education

Most colleges and universities require each student pursuing a bachelor's degree to select courses from an established set of "general education" courses. Students are required to take a writing course because writing skills are considered essential for all college graduates regardless of major, and they are required to take courses in the humanities and arts, social sciences and physical education in order to gain an understanding of the world in which they live and work. With the application of computers in society, colleges and universities have considered adding a computer literacy course to their general education requirements. Although considerable debate centers around the term "computer literacy," the content of general education computer courses tends to emphasize basic knowledge about computers and computer technology needed by all students in colleges and universities, a general understanding of how a computer operates, computer-oriented terminology, applications of computers and the impact of computers on society.

Computer Education

Within colleges and schools of education a more directed form of education must be considered. Teachers need training in the application of computers to education and, specifically, how to use that technology effectively in their teaching. Elementary teachers need training in using computers to help children learn reading, mathematics and writing; mathematics teachers need training in using computers to help students learn mathematics; science teachers need training in using computers to help students learn science; English teachers need training in using computers to help students learn English, writing and reading. Teachers need skills in using the computer as an aid and as a tool in the classroom. These concerns are considered part of computer education.

Computer Science Education

A new discipline, computer science, has been emerging in the precollege curriculum. Teachers have been teaching about computers and computing with little or no formal training. In general, teacher-certifying agencies have recognized this field only as an extension of other disciplines such as mathematics, science or business/data processing. However, as the school curriculum is clarified, the need for more in-depth training for teachers of computer science has been recognized. What training is needed for the preparation of computer science teachers at the secondary, middle school and elementary levels? Should teachers be certified in this area at the secondary level? At the elementary level? What about curriculum coordinators/developers? Do they need formal training in computer science? These questions highlight the issues involved in the preparation of computer-using educators who specialize in computer science.

FORMULATION OF COMPETENCIES

The terms general education, computer education and computer science education provided a way of organizing the presentation of the proposed competencies. The information suggested the following categories:

GENERAL
- Certification for all teachers

COMPUTER SCIENCE EDUCATION
- Specific—Elementary: Teachers capable of teaching about computers and computing at the elementary school level.
- Specific—Secondary: Teachers capable of teaching about computers and computing at the secondary school level.
- Specific—District/School Computer Curriculum Coordinator: Coordinators capable of planning, developing, organizing and directing computer science programs for districts/schools.

A modified Delphi technique approach was used to develop the set of competency guidelines within each of these categories. Information gathered was used to help describe items for each category. The initial set of competencies was sent to 45 selected administrators, media specialists, elementary and secondary level specialists and college/university specialists in teacher education, mathematics/science education, computer education and computer science. These specialists were asked to evaluate each of the proposed competencies, add any they felt were missing and clarify those that were confusing, unclear or misplaced. In the final draft, the competencies were ranked in each category in order of agreement by the specialists. Any additional items were added at the end of each of the categories.

It is important to note some of the problems encountered at this stage. The wording of the competencies was a problem for the specialists. Competencies that used educational terms were not entirely understood by computer scientists, and competencies that used computer science terms were sometimes unclear to educational specialists. This problem indicates how important it is that these groups communicate and work to clarify terminology. While an attempt was made to clarify the statements without heavy emphasis on either field, conciseness was also important.

Unfavorable feedback was received from a number of specialists and must be expected when undertaking such a survey. Examining, discussing and working through negative responses must be seen as an integral part of the whole process.

A final problem pertains to the development of the competencies. These represent the competencies specialists helped to develop *at this time*. There may be omissions, and there may be competencies that must change with the dynamic nature of the field.

EVALUATION OF COMPETENCIES

The evaluation of the proposed set of competencies in each category was done through the NCCE membership. A cover letter indicated that the proposal had been evaluated previously by selected specialists and that the competencies in each category had been presented in rank order, the first competencies in each category representing the strongest agreement among the specialists. Thus, members were given an idea of the agreement among the specialists. They were asked to re-evaluate the competencies using the scale:

1—Strongly Agree
2—Somewhat Agree
3—Neither Agree Nor Disagree
4—Somewhat Disagree
5—Strongly Disagree

One hundred ninety-two members responded to the proposal. The evaluations were compiled, mean ratings computed and the competencies reordered in each category. Any competency with a mean rating of more than 2.5 (indicating members not agreeing) was eliminated.

Problems similar to those identified in the evaluation by specialists were also noted in this phase of the project. However, lack of knowledge about computers, computer terminology and computer applications presented the most difficulty for members in their evaluations of the competencies. It is important to note that *providing a forum for educating members about the issues involved in teacher certification of computer-using educators* was part of the rationale for the project.

DISSEMINATION AND RESULTS

The final set of ranked competencies, recommended for use as guidelines for teacher education programs, was completed in January 1984. The competencies were disseminated to the NCCE membership. In addition, they were presented to the Oregon Department of Education in June, and to the National Educational Computing Conference (NECC), held in Dayton, Ohio in June. The ICCE Teacher Certification Committee is using the competencies as a starting place for their work on developing teacher certification guidelines. And now, through publication in TCT, it is hoped that these competencies will generate discussion and encourage other states and provinces to address this issue.

It should be noted that the General Certification competencies comprise both general education and computer education competencies. In order to facilitate an understanding of the meaning of these competencies, there are two columns: one for general education and one for computer education. The competency order is indicated by the mean rank.

GENERAL: CERTIFICATION FOR ALL TEACHERS

General Education

The teacher should:

1.66 have an appreciation for using the computer as a tool for solving problems.

1.69 have the experience of using computers in the learning of subject matter.

1.75 have knowledge of computer vocabulary.

1.92 be able to use the computer as a tool (using applications such as word processing, spreadsheet analysis or data base management).

2.10 be familiar with computer hardware, including the everyday operation and use of a variety of machines.

Computer Education

The teacher should:

1.43 be familiar with computerized teaching materials, including some experience in using educational application software and documentation.

1.50 understand how computer use fits into a teacher's specialization area.

1.60 be able to integrate effective computerized teaching materials into classroom activities.

1.66 be able to evaluate the appropriateness and effectiveness of infusing computerized materials into specific training/learning situations.

1.84 be familiar with sources of information on computers in education.

2.01 have knowledge in the use of computers to enhance student writing.

2.14 be knowledgeable about computer-managed instruction systems.

2.14 be able to discuss moral, psychological and sociological issues of computing in society (in general and in education).

2.23 be familiar with audio-visual materials suitable for use with computer-related subjects, including some experience in using audio-visual materials in a specific subject-matter area.

COMPUTER SCIENCE EDUCATION COMPETENCIES

Elementary: Teachers capable of teaching about computers and computing at the elementary level.

The teacher should:

1.37 meet the GENERAL competencies.

1.63 be able to evaluate and implement computerized materials for specific teaching/learning situations.

1.81 be familiar with the educational materials available for computer science education.

1.88 be familiar with the suitable range of computing topics at the elementary level (including computer operation, programming, robotics and vocational opportunities).

1.91 be able to discuss ethical issues of computer use.

1.92 utilize learning psychology for elementary students to interpret and design activities (based on the nature of the learner and the nature of the knowledge) for learning about computers and computing.

1.93 have knowledge and experience using the computer as a tool in areas such as art, music and written composition.

2.14 understand the concept of structured programming.

2.24 be able to write readable, well-structured programs in at least one programming language (such as Logo or BASIC) suitable for use at the elementary school level.

2.35 have knowledge of the criteria for creating efficient and well-structured computer programs.

2.35 have knowledge of techniques used in programming in graphics.

2.37 understand the basic computer architecture.

2.39 be able to compare and contrast programming languages suitable for elementary school level.

COMPUTER SCIENCE EDUCATION COMPETENCIES

Secondary: Teachers capable of teaching about computers and computing at the secondary school level.

The teacher should:

1.31 meet the GENERAL competencies.

1.53 be familiar with the suitable range of computing topics at the secondary level (including applications and vocational opportunities).

1.56 understand the concept of structured programming.

1.60 have knowledge of the criteria for creating efficient and well-structured computer programs.

1.62 be familiar with educational materials available for computer science education.

1.67 understand the basic architecture of computers.

1.77 be able to compare and contrast programming languages suitable for secondary school level.

1.79 be able to discuss and develop learning situations for moral, psychological and sociological issues of computing in society.

1.80 be able to write readable, well-structured programs in at least two programming languages (such as Logo, BASIC, Pascal, FORTRAN, COBOL).

1.80 utilize learning psychology for secondary students to interpret and design activities (based on the nature of the learner and the nature of the knowledge) for learning about computers and computing.

1.81 be able to explain general algorithms (such as sorting algorithms) and data structures utilized in programming in secondary schools.

1.84 have knowledge of techniques used in programming in graphics.

1.88 be able to explain graphics capabilities of a computer and programming using graphics techniques.

1.92 understand the basic architecture of high-level languages and generalized computer-programming constructs.

2.18 be able to interface a computer to simple devices to demonstrate its capability for data collection and/or control applications.

COMPUTER SCIENCE EDUCATION COMPETENCIES

Specific/District/School Computer Curriculum Coordinator: Coordinators capable of planning, developing, organizing and directing computer science programs for districts/schools.

The coordinator should:

1.23 be able to assist in selection, acquisition and use of computers, interactive terminals and computer services suitable for education.

1.26 meet the GENERAL competencies.

1.27 be able to assist in planning, selecting and implementing appropriate training programs for enhancing computer science education and education with computers.

1.27 be able to assist teachers in evaluation, selection and/or development of appropriate instructional materials using computer facilities.

1.33 be able to develop appropriate inservice teacher training programs for enhancing computer education.

1.34 be familiar with educational materials available for computer science education.

1.40 be familiar with the suitable range of computing topics at the elementary and secondary levels (including applications and vocational opportunities).

1.44 be able to assist teachers in evaluation, selection, and/or development of computer-related audio-visual instructional materials.

1.57 have knowledge of ways that a computer system can aid in the education of students with special needs, including the use of special input modes for the physically handicapped.

1.65 understand the basic architecture of computers.

1.70 be able to discuss and develop learning situations for moral, psychological and sociological issues of computing in society.

1.71 understand the concept of structured programming.

1.74 be able to compare and contrast programming languages suitable for elementary and secondary levels.

1.77 have knowledge of the criteria for creating efficient and well-structured computer programs.

1.80 utilize learning psychology for elementary and secondary students to interpret and design appropriate activities (based on the nature of the learner and the nature of the knowledge) for learning about computers and computing.

1.82 have knowledge of possible uses of computer for data collection and/or control applications as an aid in the science classroom.

2.03 have knowledge of techniques used in programming in graphics.

2.04 be able to interface a computer to simple devices to demonstrate its capability for data collection and/or control applications.

2.05 be able to explain graphics capabilities of a computer and programming using graphics techniques.

2.07 understand the basic architecture of high-level languages and generalized computer-programming constructs.

2.07 have a specialized training in curriculum or media.

2.17 be able to explain general algorithms (such as sorting algorithms) and data structures used in programming.

2.19 have the ability to write readable, well-structured programs in at least two programming languages (such as Logo, BASIC, Pascal, FORTRAN, COBOL).

2.41 have administrative training.

SUMMARY

This set of guidelines should encourage the evaluation of general education courses for teachers and the development of courses and programs which prepare teachers to teach about computers and computing. As teacher education programs continue to struggle with the issues involved in the preparation of computer-using educators, the competencies will become more clearly defined, more complete and more specific than this set. This set of competencies should be useful in encouraging discussion, debate and plans for certifying teachers in the computer science discipline.

[ICCE strongly encourages such discussion and debate through TCT and welcomes letters or articles on this topic.]

[Margaret L. Moore, President-Elect, Northwest Council for Computer Education; and Assistant Professor, Computer Science Education, Department of Science and Mathematics Education, Oregon State University, Corvallis, OR 97331.]

Reference

Taylor, H.G. and Poirot, J.L. "The Certification of High School Computer Science Teachers." Paper presented at Baltimore, Maryland, meeting of the National Educational Computing Conference, 1983.

END

Making the Computer Neuter

by
Jo Shuchat Sanders

Many teachers are noticing that most of the students who come to the computer room during their free time are boys. They are surprised, because they know they are not discouraging girls from coming and they see no gender gap in computer class. They are concerned, too, because they realize that if girls continue to avoid the computer in school, they will be forced to avoid many jobs with good pay and good advancement potential as adults.

In an article I wrote for *TCT* in April 1984 ("The Computer: Male, Female or Androgynous," pp. 31-34), I listed 29 possible causes for girls' computer avoidance identified by our Computer Equity Training Project. They include causes relating to attitudes and associations, developmental and behavioral factors, parental factors, software and computer use, and school logistics. Since then, we've learned that some of the alleged causes are simply not true, while some others are indeed valid.

The purpose of this article is to bring *TCT* readers up to date on several interesting things we've learned about computer equity for girls. But first, a quick review of the Computer Equity Training Project.

THE COMPUTER EQUITY TRAINING PROJECT

The Computer Equity Training Project is funded for two years by the Women's Educational Equity Act Program, U.S. Department of Education, to develop strategies teachers can use to increase girls' voluntary computer use. Antonia Stone, the project's computer specialist, and I are focusing especially on the middle school, since this is the age at which the computer gender gap usually becomes apparent.

Working with three pilot test schools in the spring of 1984, we developed a number of promising school-based strategies and have been using that information as well as suggestions from other teachers across the country to compile the draft version of our book. It will be called *The Neuter Computer: Why and How to Encourage Computer Equity for Girls,* and it should be useful to teachers in elementary and high schools as well as those in middle or junior high schools. At this writing, we are preparing for a field test of the book at three other schools. The book will be revised and published in early fall, 1985.

Over the course of the last year, we've done several analyses and studies we'd like to report on at this time. They concern the presence of females in computer magazines, how home computer use varies by sex, a student software evaluation, and indications that a couple of widely held beliefs about the computer gender gap may be wrong.

WOMEN IN THE COMPUTER MEDIA

We analyzed four issues of large-circulation computer magazines that appeared February through June 1984. The magazines—*Compute!, Personal Computing, InfoWorld* and *Popular Computing*—are ones that parents and teachers with computer interests could be expected to read. We wanted to find out by counting, not by vague impression, whether the computer world as depicted in these magazines is as male as many people suspect it is.

It sure is.

First, we counted photographs of people who were directly involved with computers, either passively (watching other people use computers or demonstrate computer products), or actively (using computers or demonstrating computer products oneself). We found a total of 172 such photographs in the four magazines and analyzed them according to sex and passive/active use.

Photographs of People in Computer Magazines

	Passive Computer Use	Active Computer Use
Total number of photographs	28	144
Percent photos of females	36%	17%

We then looked at the feature articles about prominent individuals in the computer industry. Only one article in the four issues was about a woman, and it focused on her views as a woman in a male-intensive industry, rather than on her experience as the executive of a software company. There were also two columns of briefer profiles, in which one of the seven people described was a woman. This was Gloria Steinem, and the profile described how she had been asked by a software developer to assess the marketing strategy of a line of software intended for a female market, to be sold on hangers and featuring such topics as houseplant care.

Finally, we counted the authorship of all bylined articles in the four issues. Of the total of 91 such articles, 76 percent were written by men, 12 percent by women, and 12 percent by authors whose sex we could not determine from their names.

Teachers and parents who read such magazines can hardly be blamed for expecting that computer users will be male. No less an authority than the Director of Educational Marketing for Apple Computer, Gregory Smith, was recently quoted as saying, "The buyers of Apple computers are 98 percent male. We do not feel that women represent any great untapped audience." It is easy to see how such an attitude can become a self-fulfilling prophecy.

GIRLS AND BOYS AND HOME COMPUTERS

We conducted a survey about home computer ownership and use last spring with 459 seventh and eighth graders at the three Computer Equity Training Project pilot test schools (Franklin Junior High School in Whitewater, WI; Waldport Junior High School in Waldport, OR; and Mt. Hebron Middle School in Upper Montclair, NJ). Thirty-seven percent of the boys reported having a computer at home, as opposed to 28 percent of the girls. Of the children who had computers at home, 11.1 percent of the girls but only 3.5 percent of the boys said they did not use them at all.

When asked who used the computer most at home, the computer-owners replied as follows:

WHO USES THE HOME COMPUTER MOST? FROM MOST (#1) TO LEAST (#8)*

Boys say:	Girls say:
1. Self—67%	1. Brother—24%
2. Self and father or brother —9%	2. Self—21%
3. Brother—7%	3. Sister—13%
4. Father—6%	4. Miscellaneous others or no one—13%
5. Miscellaneous others or no one—5%	5. Father—11%
6. Mother—4%	6. Self and father or brother —10%
7. Self and mother or sister —1%	7. Mother—10%
8. Sister—1%	8. Self and mother or sister —0%

*Percentages do not add up to 100 due to rounding.

A pattern emerges from these results of relatively intense computer use by males and rather diffident use by females. Boys were more than three times as likely as girls to say they used the computer most at home—67 percent vs. 21 percent. Boys also reported much heavier computer use exclusively by males (self, father, and/or brother, at a total of 91 percent for ranks 1 through 4) than girls did for exclusive female use (self, mother, and/or sister, at a total of 44 percent for ranks 2, 3, 7 and 8).

Obviously, the computer equity problem extends beyond the school walls. Teachers need to make special efforts to make sure that the lackluster female computer-use pattern at home is not carried over to the school environment. These results also suggest that a computer equity program in a school would be well advised to include some parent education along with strategies directed at the girls themselves.

STUDENT SOFTWARE EVALUATION

Having read as many articles on computer equity as we could find in popular as well as scholarly publications, we were struck by the fact that nearly every author pointed to violent software as a leading cause of the computer gender gap. It sounded legitimate to us until we realized that the writers were quoting each other as authorities. None of the writers had actually done any studies to find out whether there is, in fact, a difference in the way girls and boys respond to software.

We chose three educational computer programs that we thought would appeal unequally to girls and boys:

- *Mastertype.* A program that teaches typing by having students type words quickly and correctly enough to avoid having their spaceships blown up by missiles fired from the words in the corner of the screen. To make sure the kids didn't miss the point, we characterized this program as an "action shooting program" in the questionnaire.
- *Factory.* A pattern-recognition program in which students must operate three "machines" that rotate a square a variable number of degrees, punch a variable number of holes in it, and paint a stripe of variable width on it in order to duplicate patterns generated by the program. We called this a "machine program" in the questionnaire.
- *Missing Links.* A language arts program in which the student selects a text from a list of choices and selects the level of difficulty according to the number and placement of blanks instead of letters in the text. The student must replace the blanks with correct letters. We called this a "story program" in the questionnaire.

The rather surprising results, obtained with 361 seventh and eighth grade boys and girls, are presented below.

SOFTWARE EVALUATION SURVEY

	Mastertype		Factory		Missing Links	
Question	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**
1. Grade the program (0-100):						
a. Overall grade	87	81	86	87	88	83
b. Fun and enjoyment	83	81	85	80	88	78
c. Held interest	83	84	82	79	85	78
d. Looked on screen	86	86	90	88	87	79
e. Sound effects	86	83	88	83	81	64
f. Helped you learn	82	85	75	73	82	77
Average ratings	85	83	84	82	85	77
2. How much do you like "action shooting"/"machine"/"story" programs? (5 = love them; 1 = hate them)	3.9	4.1	3.7	3.8	3.9	3.4
3. Would you like to play it again? (Percent answering yes)	83%	82%	72%	68%	85%	65%

According to these results, there was a clear sex difference only for *Missing Links,* the language arts program, which girls liked much better than boys on all the measures. (They even gave it an 81 for its sound effects as opposed to the boys' 64. This is interesting in light of the fact that except for an occasional beep for wrong answers, the program has no sound effects!)

Another interesting result is that whereas girls were slightly more likely to give *Mastertype* higher "grades" and to say they would like to play it again, they rated "action shooting programs" slightly lower than boys did. The differences were not great, however.

Thinking about these findings leads us to one useful conclusion: Girls find "story" programs appealing. The wise teacher would provide as many language arts uses for the computer as possible in order to attract girls to the computer.

We had hoped for an equally clear result on "action shooting programs" in view of their widely held role as culprit for the sex difference in computer use, but we didn't get one. This may be due to the fact that *Mastertype,* in addition to its spaceship and missile character, which may, in fact, appeal more to boys, is also a program that teaches typing, perhaps of more interest to girls. If so, the two trends might have cancelled each other out. This is a possibility we had thought about beforehand, but we could not bring ourselves to present to children a truly violent program with no redeeming social importance. Certainly, *Mastertype* is pretty tame stuff when compared with such programs as *Global Thermonuclear War,* in which players develop strategies for destroying the world, complete with human and economic casualties. Other researchers with stronger stomachs than ours may want to give children a more extreme example of a shoot-'em-up than *Mastertype* in order to learn more than we did on this score.

Recognizing full well that we still don't know the definitive answer to the question of whether macho software turns girls away from computers, I am coming to think more and more that the question itself is irrelevant. A far more important question to answer is whether it is good for children of either sex. I can't believe that we want to instill in children an approach to problem solving that features destroying the opposition as the only way to "win." We are beginning to see some software on the market designed for girls, software that is supposed to stress cooperation rather than conflict. In my view, although such software is useful for calling attention to the problem, it cannot be seen as a solution. If we have good software for girls, will we leave the garbage in place for boys? And if we have girl software and boy software, shouldn't we have girl math books and boy math books, girl readers and boy readers?

"Recognizing full well that we still don't know the definitive answer to the question of whether macho software turns girls away from computers, I am coming to think more and more that the question itself is irrelevant. A far more important question to answer is whether it is good for children of either sex. I can't believe that we want to instill in children an approach to problem solving that features destroying the opposition as the only way to 'win.'"

It seems to me that if teachers would not permit children to read magazines on pornography or sadism in school on the ground that such material is harmful to their emotional and social development, teachers should not permit children to play computer games that teach them to annihilate whatever gets in their way. If violent software isn't good for girls, it's bad for boys, too.

FEMALE VS. MALE TEACHERS

A reason often alleged to account for the computer gender gap is that most computer teachers are male, resulting in a lack of role models of the girls' own sex. This, the thinking goes, subtly discourages girls from active computer use. Our evidence doesn't entirely support this contention.

The theory actually has two parts to it, the first dealing with the actual sex distribution of computer teachers. We know of no such figures, but our contacts with computer teachers across the country do not support the male-majority belief. It seems to us that at least half of the computer teachers are women. (Might this be because more males with computer skills get high-paying jobs in industry, leaving school jobs to be filled by women?) In our three pilot test schools, one had a male computer teacher, one had a female computer teacher, and in the third school a man taught the computer classes while women staffed the computer room. All three schools were accepted into the pilot test because they had sex imbalances in voluntary computer use after school, averaging 78 percent male. In these schools, at least, having female computer teachers wasn't the answer.

The second part of the theory implies that girls are better able to model their computer-use behavior on female than male teachers. While we found some support for this contention, it was far from the most significant factor.

Each pilot test school distributed one or more questionnaires to its seventh and eighth grade girls at the end of the semester in order to assess the relative effectiveness of the computer equity strategies it had implemented. Questionnaires were administered to 127 girls in Wisconsin, 70 girls in New Jersey and 53 girls in Oregon. The Wisconsin girls were asked about having female and male computer teachers:

- Eleven percent of the girls agreed that seeing female teachers use computers encouraged their computer use.
- Seven percent of the girls agreed that seeing male teachers use computers encouraged their computer use.

This was the only question we had that specifically contrasted the male/female teacher influence, and it indicated only a slight advantage to female teachers. However, other end-term questions asked girls the extent to which a variety of factors, including a female computer teacher, encouraged their use of computers. The female-teacher factor does not appear to be particularly powerful when compared to several others:

Does this factor encourage your computer use?	Percent of girls saying Yes
Seeing female teachers use computers	32% (OR) 22% (NJ) 19% (WI)
"Girls only" computer sessions	42% (OR) 29% (WI)
Koala Pad	48% (OR)
Computer class	61% (NJ) 42% (OR)
Logo	54% (OR)
Computer bulletin board	20% (OR) 11% (WI)

According to this evidence, having a female computer teacher certainly doesn't hurt and might even help to a limited extent. Nevertheless, it clearly is not The Answer to the computer gender gap. Other factors appear to be more important than the sex of the teacher in increasing girls' computer use.

FRIENDS AND ENEMIES

A reason often cited for the absence of girls from the computer room is the presence of boys. Pre-adolescent girls, the reasoning goes, prefer to be as far as possible from pre-adolescent boys. On this premise, some schools have set up a computer lab for girls and a computer lab for boys, while others reserve the computer room for one sex or the other at different times. There's no question about the success of the strategy: Each of our three pilot test schools instituted "girls only" and "boys only" computer sessions after school, and all reported increased attendance by girls.

Nevertheless, the premise is not true.

One of the most fascinating findings of the various end-term questionnaires related to the sex of the other students in the computer room. The questionnaire used in New Jersey and Oregon asked girls to contrast the likelihood of their using computers when girls vs. boys were also using them. In both cases, the presence of female friends was a more encouraging influence than the presence of male friends, but a substantial minority responded that the presence of male friends would be encouraging as well:

- **"Would you be more likely to use computers if *girls* you like use them?"**

	New Jersey ($N=70$)	Oregon ($N=53$)
Yes	65%	56%
No	35%	44%

- **"Would you be more likely to use computers if *boys* you like use them?"**

Yes	48%	33%
No	52%	66%

Another New Jersey/Oregon question asked about the influence of several factors in *discouraging* computer use. Far and away, the absence of friends was the most powerful factor here:

- **"If a girl isn't interested in computers, do you think it is because:"** (Multiple answers were permitted.)

	New Jersey	Oregon
Computers are boring.	21%	19%
Learning to use computers is too hard.	24%	19%
Computers are not useful.	1%	0%
Her friends aren't interested in computers.	50%	40%
She's afraid.	10%	8%
Other reasons (too many boys, not interested, no time).	18%	27%

- In Wisconsin, 58 seventh-grade girls and 65 eighth-grade girls were asked, **"How have the following things changed your computer use?"** We've ranked their responses according to the percentage of girls who reported that the factor made them use computers more, from 1 as most effective to 9 as least effective. Here, all three factors—friends, girls, and boys—were included in a list of nine possible influences.

	7th Grade Rank	7th Grade %	8th Grade Rank	8th Grade %
Seeing your friends use computers	1	50%	1	52%
Girls' Computer Lunch Period	2	39%	3	20%
Seeing girls use computers	3	28%	2	22%
Parent workshop	4	22%	4	17%
Seeing boys use computers	5	19%	5	14%
Seeing female teachers use computers	6	14%	7	9%
The computer bulletin board	7	14%	8	9%
The computer art contest	8	12%	6	11%
Seeing male teachers use computers	9	9%	9	5%

According to these findings, it's not quite true to say that girls object to the presence of boys in the computer room, as many people have thought. Rather, they seem to object to the absence of their friends, who at middle-school age are likely to be other girls. This is a subtle distinction, but an important one. Reserving the computers for girls apparently works because the strategy makes the presence of their friends likelier.

"... it's not quite true to say that girls object to the presence of boys in the computer room, as many people have thought. Rather, they seem to object to the absence of their friends, who at middle-school age are likely to be other girls.... Reserving the computers for girls apparently works because the strategy makes the presence of their friends likelier. The implication for teachers is that they need to encourage groups of girls—friendship groups—rather than individual girls to use the computer."

The implication for teachers is that they need to encourage groups of girls—friendship groups—rather than individual girls to use the computer. It is, of course, possible to do this within the framework of a "girls only" session, which is why the strategy works. We would urge, however, that schools maintain it only long enough for girls to become involved with computers, by which time it shouldn't matter to them who else is in the room. Sex-segregated computer rooms may be useful in the short run, but in the long run they should be unnecessary and in fact counter to the spirit of educational equity.

PEOPLE AND MACHINES

Going back to the New Jersey/Oregon questionnaire administered at the end of the pilot test term, a question was included to find out whether it was true that pre-adolescent girls have a need for social interaction that is not met when one student is assigned to one computer and talking is discouraged.

This idea, we discovered, was borne out by the results.

The question was: "**Which of the following best describes the way you would like to work with computers?**" (Multiple answers were permitted.)

	New Jersey	Oregon
I like to work alone when no one else is around.	15%	23%
I like to have a computer to myself, but I don't care if someone else is working at another computer nearby.	46%	35%
I like to share a computer with a friend and work together.	51%	46%
I like to be part of a group of people working on a computer.	7%	4%

According to these answers, a computer environment that emphasizes paired work at a single machine or encourages discussion among students at several machines should indeed be more effective in encouraging girls' computer use than one in which students are isolated from each other. Teachers in our pilot test schools and elsewhere say that despite initial reservations about chaos in the classroom, allowing students to consult with each other about their work at the computers results in more enthusiasm and better work.

SUCCESSFUL COMPUTER EQUITY APPROACHES

Based on these findings, as well as on other pilot test experience and interviews with many classroom and computer teachers across the country, we have identified five general approaches that seem to be helpful in encouraging girls to use the computer during their free time. They are:

1. **Structure the Free Time.** A sign-up schedule that guarantees computer time for girls is important, since the reason for computer equity effort in the first place is that boys usually crowd out girls in the computer room. You can divide the sign-up sheet down the middle for boys and girls to ensure equal time. This should be a transitional measure, like the "girls only" after-school computer time, but be prepared to re-establish it if the attendance pattern becomes seriously imbalanced again.

2. **Make the Herd Instinct Work for You.** For reasons described above, target *groups* of girls rather than individual girls as potential computer users. Once computers are seen by girls as an "in thing" to do (and be seen doing), you're home free.

3. **Friendliness at the Computer.** Again, for reasons discussed above, encourage social interaction in the computer room. Students can be paired at the machines, taking turns with the typing. If students are working on individual programs, they can still be allowed to ask each other for opinions and suggestions as they work.

4. **The Computer as Tool, Not Toy.** There are two good reasons for using school computers for practical, goal-oriented purposes. One is that, according to all the computer teachers we've spoken with, girls seem to prefer using a computer as a means to an end, while boys appear to enjoy using it as an end in itself. To encourage greater computer use by girls, therefore, stress school-related computer uses such as word processing, data base programs and graphics. The second is that these are *school* computers, which presumably ought to be used for educational goals. There is nothing educational about shoot-'em-ups.

5. **Bait Your Hook.** If girls are going to want to continue their computer involvement through high school and on into jobs, they need to enjoy using the computer now. Your goal is to keep their hands on the keyboard and their eyes on the screen. Provide them with computer activities they like to do—find out what that is by asking them and by offering them choices—and they will keep coming back.

In the fall of 1985, the Computer Equity Training Project will publish *The Neuter Computer: Why and How to Encourage Computer Equity for Girls.* After the field test and the final revision, we expect the book to have over 50 classroom, schoolwide, parent and community/funding strategies teachers can use to make the computer far more neuter than it is now. The strategies will range from those that require no teacher effort at all to those that require a martyr to the cause, and everything in between. There will be strategies for all subject areas, strategies for student extracurricular activities, and strategies for enlisting the aid of parents and the community in the computer equity effort. Stay tuned for the next exciting installment. . . . **END ■**

[Jo Shuchat Sanders, Director, Computer Equity Training Project, Women's Action Alliance, 370 Lexington Avenue, New York, NY 10017.]

DATABASING

in the Elementary (and Secondary) Classroom

by
Kathy Pon

As a first-year teacher, I was given a third-fourth grade combination class full of curiosity. They all were excited to learn about Indians, and we spent many wonderful days studying them. I say "we" because I enjoyed the subject as much as the class. However, the following year, I faced the problem of what to teach my fourth graders, whom I had had the previous year as third graders. The majority of them wanted to study Indians again, but what details were left?

Fortunately, I've always had an interest in developing higher-level thinking skills in students. This prompted some research which resulted in the piloting (gulp) of an exciting tool that aids higher-level thinking in the classroom—use of database management as an inquiry tool.

The application of database management for inquiry is grounded in cognitive learning theory as it operates within Piaget's framework of the concrete, symbolic and abstract learners. Students gather data on a given academic topic in a number of concrete ways. For example, they examine different books, films, maps, museums, etc., for information. They then label and group their information in a meaningful, symbolic manner—that of the database form. Finally, with more analysis they are able to synthesize the pieces of data and combine them in new and different ways. Students can then make and test more abstract generalizations about the information.

Hilda Taba had teachers and students using this data retrieval method for learning, although she did it with paper and pencil. In one study she did using this method, she found that students who were given practice at making generalizations were able to make increasingly valid generalizations about their data, i.e., think more effectively. The students, therefore, were meeting multiple learning objectives with the same activity. They were increasing their knowledge and improving the quality of their thinking.

How does an elementary school teacher introduce the use of database management into the classroom? With enthusiasm, a critical examination of the many database programs available and careful management planning. Consider the educational possibilities of this tool as I describe my experience in using it in the classroom.

The first step was to have students gather data. Because they were studying California Indians, they found most of their information in our local library and Indian museum.

Sample of a Primary Data Chart on Maidu Tribe

INFORMATION COLLECTED	LABEL OR ATTRIBUTE GIVEN LATER
Their houses were made of tules. They were round. They looked like bowls.	Home
They lived near or in the Buttes Mountains. The city nearby is called Yuba City. It is in Sutter County. They lived near the Feather River.	Location
They mostly ate acorns. They ate deer and small animals. They fished. Ate seeds.	Food
Men hunted and fished. Women gathered acorns and cooked.	Jobs
They danced and made musical instruments with reeds, especially at acorn harvest. They told stories. Had albino deer and acorn ceremonies.	Recreation, Special Ceremonies
They used mortars and pestles to grind acorns with. They hunted with bows and arrows and fished with harpoons.	Tools
They wore hides and rabbit skins in winter. They used moccasins with high ankle covers for the mountains.	Clothing

Figure 1.

Next, they designed a form on which to display this data, using a label to classify each piece of information such as FOOD or HOME. This form was entered on the computer database.

Completed Student Computer Database File

TRIBE	MAIDU
LOC	N V BUTTE MTNS YUBA CITY
CLI	COOL WINTERS & HOT SUMMERS
HOME	BARK OR BRUSH, BOWL SHAPE TEMPORARY
FOOD MAJ	ACORN DEER FISH
FOOD MIN	NUTS SEEDS BULBS BERRIES
JOB M	HUNTING TRAPPING FISHING
JOB FM	GATHERING, FOOD PREP KIDS
CLO	SKINS IN WINTER MOCCASINS
SPEC TOOLS	DIGGING STICK MORTAR NETS
OUTSTD FEAT	ACORN & ALBINO DEER CERE. USED SWEATHOUSES
TRIBE	MIWOK—MOUNTAINS
LOC	C V CHAW-SE PARK NEAR YOSEMIT
CLI	MILD-COOL WINTERS & HOT SUMMERS
HOME	TULE BRUSH SHELTERS—TEMPORARY
FOOD MAJ	ACORNS FISH
FOOD MIN	ROOTS BULBS SM GAME
JOB M	HUNTING FISHING
JOB FM	GATHERING, FOOD PREP
CLO	LIGHT TO NONE—BAREFOOT
SPEC TOOLS	MORTAR & PESTLE
OUTSTD FEAT	SWEATING NECESSARY FOR UNT SOME AGRESSIVE
TRIBE	POMO—NORTHEASTERN
LOC	N V CLEAR LAKE & N COASTAL MTN
CLI	COOL WINTERS & HOT SUMMERS
HOME	BARK TIPILIKE OR BRUSH TEMP
FOOD MAJ	FISH ELK DEER SEA OTTERS
FOOD MIN	NUTS SEEDS BERRIES
JOB M	HUNTING FISHING TRAPPING
JOB FM	COOKING GATHERING KIDS
CLO	SKINS IN WINTER, LITTLE—MOCCA.
SPEC TOOLS	BALSA BOATS NETS HARPOONS
OUTSTD FEAT	MADE BEAUTIFUL TWINED AND COILED BASKETS CLAMS $$

Figure 2.

I conducted small-group sessions at the computer where students were then able to generalize about attributes that seemed to be related. We sometimes used Venn diagrams as in figure 3. I showed the students commands and procedures that enabled them to check their generalizations by making data searches for tribes that listed these criteria. Thus, their generalizations could be verified. For example, "Tribes that lived in the North seemed to wear skins and furs for clothing" was decided to be a relationship. By searching for tribes that met the stated generalization, students were able to check for tribes that listed the information SKINS under CLOTHING and NORTH under LOCATION.

Only a small group of my students discussed possible causes and effects. Most students were not cognitively ready to create hypotheses about causes and effects of the data and test them by making a database search. Instead, they concluded the study by discussing why they thought certain attributes were related.

Venn Diagram on Two Whole Tribe Comparisons

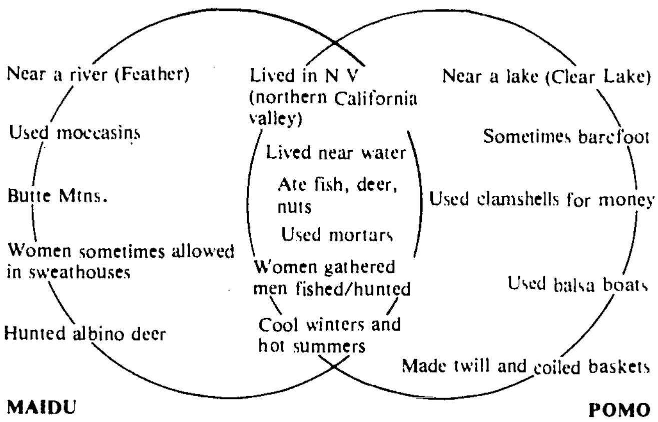


Figure 3.

However, one group continued the last part of the study before and after school. They took the generalizations made earlier at the computer and turned them into if/then statements. They then tested them for a cause-and-effect relationship by writing a null hypothesis statement and objectively testing it by locating the information in the database.

Students practiced the skill of making if/then statements and related null hypothesis statements on non-Indian subjects like this:

1) Practice with a generalization
   "It seems like rain and umbrellas go together."
2) became an if/then statement
   "If it rains, then the number of umbrellas on the street will increase."
3) and then was written as a null hypothesis statement:
   "On a rainy day the number of umbrellas will not increase on the streets."

Likewise, they developed this generalization from their study of California Indians,

"Indians who ate acorns used mortars and pestles."

wrote it as an if/then statement

"If Indians ate acorns, then they used mortars and pestles."

and then wrote the following null hypothesis statement:

"Indians on the database who have acorns listed under FOOD will not list mortars and pestles under TOOLS."

The exciting part about working with the concepts at this level was the discussions about the validity of the data retrieved. Could it have been found with different wording? Even if the hypothesis was validated, did it really *prove* a cause and effect? Perhaps Indians who ate acorns used the mortar and pestle to wash clothes. The students became more critical than I would ever have expected them to be in examining their findings.

The most rewarding part of this study was at the end of the unit, two months later. I put together my own Indian database on tribes that my students had not studied. After students reviewed patterns they had observed, I planned to give an attribute of an unknown tribe (such as "these Indians wore little clothing") and have students make an inference about another related attribute or generalization based on the established patterns (such as "they must have lived in a warm climate"). I thought that if I required students to give reasons for their choice of attributes, that that would be a valid evaluation of their level of thinking. Imagine my surprise when I got more than that! Here's an example:

The pattern that "most tribes that ate shellfish had some sort of money system" was established. I then gave them the fact that "the Chumash tribe near Santa Barbara ate shellfish." I only expected the generalization that "they probably had a money system, because tribes who had access to shellfish usually used the shells in trading" in return. Instead, I heard statements like, "They must have used boats if they fished in the sea," or "They probably hunted in groups for sea lions," or "The boats must have been made of some sturdy wood (planks) to withstand the sea." The kids had used a great deal of imagination in their thinking!

Many powerful database management programs often used in businesses are not always as useful in an educational setting. They may be able to make as many as 20 different combinations of "and + or" searches, which is valuable when making generalizations about related attributes. However, these same database management programs may not be set up to retrieve data on a single attribute from every page in the file. (To show, for example, FOOD for every tribe in the database.) Most importantly, business programs can be very structured and be vague in their documentation, which limits their use with children.

Less-structured database management programs are being developed. Some don't have the power to make as many "and + or" combinations of searches as a business-oriented database, but they do an excellent job at finding one "and + or" statement at a time. They also locate and print isolated attributes from each page in the database. The forms are less structured, which is excellent for children. They also give "help menus," easily accessible instructions, for setting a form or making a search on the computer monitor. One program now out even comes with some ready-made forms for class lists and book reports.

At a time when many databases or spreadsheets are on the market, educators should consider their students' cognitive level and adopt one that is appropriate for their particular classroom use. Content areas like social studies or science that have topics with many attributes (countries, the plant or animal kingdom, cities, for example) work well for this kind of study. Not only are these tools giving students a way to manipulate the overwhelming amount of information in society today, they are providing students opportunities to create strategies for critical thinking, perhaps the most useful skill for the eighties and beyond. END■

[Kathy Pon, Dos Palos Joint Union School District, 2041 Almond St., Dos Palos, CA 93620.]

Bibliography

1. Taba, H., *A Teacher's Handbook to Elementary Social Studies: An Inductive Approach*, (2nd edition), Addison Wesley, 1971.
2. Taba, Levine and Elsy, *Thinking in Elementary School Children*, San Francisco State College, 1964.
3. Taba, H., *The Taba Social Studies Curriculum*, Addison Wesley, 1969.

A Comparison of Three Available Commercial Database Management Programs Based on Criteria Appropriate for the Classroom

Criteria	Instant Recall	Quickfile	DB Master
Flexibility and loose structure in setting up a form	X	X	
Power to make "and" search	X	X	X
Power to make an "and" + "and + or" search		X	X
Ability to add categories to a form already set up	X	X	
Overall ease of use	X	X	
Power to isolate one category or attribute from all pages in the database and display/PRINT it		X	
Command to allow for spelling errors	X	X	X
"Help screens"	X	X	

Figure 4.

A Road Atlas for Computer Literacy and Teacher Training

by
William E. Baird

[An earlier version of this paper appears in the NECC '84 Proceedings, *and copyright is held by the NECC Steering Committee.]*

Two Case Studies

Frank had known it was coming for quite some time now. Like distant thunder from over the horizon, the sounds of approaching change had crept incessantly closer until he could no longer ignore the personal impact of the approaching storm. But until today direct confrontation had not been necessary.

Frank is a ninth-grade social studies teacher. He likes his work and has a strong affinity for teenagers. He has a rare gift for making history come alive and paints vivid pictures of the people and events that otherwise lie entombed within the dryness of textbooks. Both his students and his peers know that he is an excellent teacher.

But last Monday when his principal decreed that all faculty would attend today's inservice training session on computers in education, he had an uneasy feeling that it would be an unpleasant experience. Frank considers computers and arcade video games to be in the same category—fine in small doses for those who enjoy playing with them, but definitely not for him.

Aleta is a math teacher from the same school. She and Frank are good friends. She is also a very good teacher and tends to be especially meticulous in her algebra and geometry classes. Aleta was one of the first in the middle school to show an interest in microcomputers. She often asked her principal to buy one for the school, but was always told that the central office would not provide money for such "frills." Two years ago she finally organized a committee within the PTA to begin a fund-raising campaign.

She has had a computer in her classroom for over a year now. She meets with her best students every day on her planning period to find out what new discoveries they have made about its performance. She is comfortable with its presence and describes it as "the most exciting thing that has ever happened to me in teaching."

Both Aleta and Frank are headed across town to attend a two-hour computer literacy inservice program. As they meet in the parking lot, Aleta is all smiles and is somewhat surprised when Frank seems unusually cool and preoccupied.

An expert has been brought in from out of town to present the training. He is a businessman, dressed comfortably in a light suit. The superintendent mentions in his introduction that the speaker is affiliated with the microcomputer company that manufactures the ZX-3.

Aleta has been looking forward to this inservice—the first of its kind for the district. It indicates to her that the superintendent is finally acknowledging the potential of computers in education. Perhaps now she will be able to get more software for the microcomputer which the PTA bought. Aleta spent most of her free time last summer teaching herself to write programs in BASIC for the new machine. Some of her students came over too, both to learn and to teach her. She is now ready to learn from an adult about interfaces, peripheral devices, memory expansion and high-resolution graphics. Maybe the speaker will demonstrate ways to write useful programs in BASIC and even talk about ways to access the computer at the local college.

The speaker begins by asserting that in the year 1990, 40 million Americans will need to be functionally computer literate just to hold their jobs. He notes that if this many people are to be trained in computer use, all existing educational institutions must be pressed into service. All teachers, not just math teachers, will be expected to use the computer in their classrooms and therefore should begin at once to make themselves "computer literate." Frank feels a knot beginning to grow in his stomach.

After a few more transparencies which seem to have been designed to make 50 teachers with collectively over 600 person-years of classroom experience feel suddenly illiterate, the speaker moves on to talk about equipment. He mentions that the company with which he is associated was one of the first to enter the educational market. Noting that most of the profits still come from business, he proudly distributes brochures showing smiling groups of students crowded around the ZX-3. He points out some of the system's competitive features and notes that the price of the ZX-3 has been reduced for a brief time only to schools in this district by special arrangement with the superintendent, whom he praises as a truly far-sighted man. Aleta notes that this is not the system she obtained by selling doughnuts on Saturdays with the PTA, and none of the programs she now uses with her algebra and geometry classes can be used with it.

The second hour is devoted almost entirely to programming the computer. After briefly mentioning that BASIC is now 20 years old and therefore practically obsolete, the speaker launches into a glowing description of GRAFGO—a new graphics language for engineering and business applications. Like a concert pianist, he sits down at the keyboard of ZX-3 and deftly calls up a program which draws geometric patterns in multiple colors on the rear-screen projector. Aleta begins to feel her palms grow sweaty.

Describing his experiences as an engineering student, the speaker draws in several additional programs to plot ballistic trajectories and perform Fourier analysis on square waves and sine waves. "It can operate in eight modes," he says, "and each mode is capable of handling up to nine waveforms!" After a *brief lesson on the power of recursive programming, he asks if someone from the audience would like to come up and try it. No one volunteers. Frank is feeling quite ill.*

After a swelling conclusion reminiscent of a gospel minister at a summer tent revival, the speaker asks if there are any questions. To break the embarrassed silence, Aleta asks if the ZX-3 can be connected to the local college computer across town so that some of her better students could use a series of tutorial programs without having to leave their own school. The speaker launches into a five-minute lesson on Baud rates, parity, duplex and seven-bit data words, ending with his vision of satellite connections permitting anyone with a ZX-3 to have instant access to any library in China. There are no more questions.

With a confident click, the speaker closes the clasps on his thin briefcase and thanks the teachers for their attention. He shakes hands with the superintendent, who has been out of the room for most of the session. There is no applause. The meeting is over. Frank hopes that fresh air will dispel his lightheaded, queasy feeling.

Frank and Aleta walk quickly back to the parking lot and drive home in silence.

What Is Computer Literacy?

Frank and Aleta have been provided training in "computer literacy." The fact that neither the principal, superintendent or the inservice speaker defined the phrase in operational terms contributed to the failure of the session. This inservice program was planned for a heterogeneous group of experienced teachers. They came with differing concerns and feelings toward the innovation, and different existing skills and needs for skills. They were given a narrow description of computer hardware and applications which applied to few or none of them. No one realized that the same prescription would not be appropriate for all teachers. This type of inservice does a great disservice to the potential of computers in education.

A clear working definition should always precede use of the phrase "computer literacy." If "computer literacy" exists at all, then its acquisition, like that of reading literacy, is a *process*—not an event. It is made up of a graduated sequence of skills which grow out of a similar sequence of needs. It proceeds from simple "grammar rules" through creative application of "prose" and "poetry" for expressing complex thoughts and ideas. Proficiency with computers, like proficiency in reading and writing, emerges from practice in applying some early rules in everyday situations of interest to the learner. We don't expect students new to writing to manifest the skills of those with many years of practice; likewise, we should not be surprised or disturbed if novice computer users do not initially learn to use the computer creatively.

A taxonomy of concerns, need for skills and level of proficiency in an educational setting can help to clarify the current situation, which confuses and frightens many teachers. It can be used in designing scope and sequence plans for inservice programs, college courses for educators and certification programs at all levels. And at the very least it can encourage those who use the worn-out phrase "computer literacy" to define its meaning as a process which permits teachers to seek specific skills which they currently need.

"A clear working definition should always precede use of the phrase 'computer literacy.' If 'computer literacy' exists at all, then its acquisition, like that of reading literacy, is a process—not an event."

Level of Concern

Gene Hall and others (1981) use a concerns model in their study of how adults adjust to innovations in which they distinguish between the development and the dissemination of new ideas in education. The model defines seven levels of concern:

0. **Awareness**—Lack of concern, perhaps resistance to change
1. **Informational**—Desire to know more about the process
2. **Personal**—Concern for the impact of the process on the individual
3. **Management**—Concern for finding time and resources to learn about the process
4. **Consequence**—Thoughts of how the process will impact one's students
5. **Collaboration**—Desire to relate new experiences with the process to others
6. **Refocusing**—Sufficient experience with the process to create variations and improvement

Level of Need for Skills

David Moursund (1982) has described computer literacy as a spectrum of skills arising from needs which teachers may have in their subject area at their grade level. Thus, any teacher should acquire those skills with computers which facilitate their efforts in teaching. Much of the current confusion and perhaps some of the resistance to computers by educators might be alleviated if more publishers, teacher training institutions and consultants recognized that not all teachers need to know how to program a computer in order to benefit from its use.

It seems reasonable to apply Moursund's seven categories of end uses for computers in education as columns of need for skills in the taxonomy matrix. Acquisition of skills across these columns requires increased time and experience on the part of users. However, not all teachers need to acquire all seven skill levels, and some teachers will not move sequentially through the levels. Some teachers may be in more than one column at a time, perhaps using application programs in one area while experimenting with programming.

0. **Pre-skill**—Entry level; may be accompanied by some anxiety about computers
1. **Orientation**—Ability to turn on the computer, load a program from tape or diskette and use prepackaged software by following directions from the screen
2. **Evaluation**—Ability to appropriately use and critically evaluate most available software for the user's grade level; can select from a variety of software that which is best suited for the classroom
3. **Application**—Ability to use the computer as a learning "amplifier" in the classroom; drill and practice,

computer-assisted instruction, tutorials, games and simulations are included in the repertoire of this user.

4. **Programming in the Small**—Ability to read, write and modify short computer programs of less than 300 lines in a single language such as BASIC or Logo; may teach simple programming
5. **Programming in the Large**—Ability to write larger programs in at least two high-level languages using a procedural approach so that the problem to be solved by the program is broken up into smaller subtasks, each of which is a subroutine in the larger program
6. **Computer Science Concepts**—Ability to apply sound principles of computer science to the selection of appropriate data structures and algorithms in routine authoring of programs longer than 600 lines; could conduct an advanced placement course in computer science such as the one described by Garland (1983) for the Educational Testing Service

It is apparent that a one-hour inservice program could move a novice from skill level 0 to level 1, whereas nothing short of an undergraduate major in computer science would provide the skills in level 6. A full-day inservice program perhaps could move a teacher from skill level 1 to level 2, but a year of experience might be necessary to move from there to level 3—the application of existing software at appropriate times in the classroom.

Crossing over into programming in levels 4 through 6 (even if it is done with the aid of an authoring language) requires a much higher expenditure of time and effort. The difference between skill levels 0-3 and 4-6 might be compared with the difference between being an airline passenger and deciding to become a pilot. It may be more fun to direct the plane from the cockpit, but it requires much more commitment than sitting back and enjoying the ride as a passenger. Not all of us need to be pilots in order to benefit from powered flight. Nor must we all become programmers in order to benefit from computers in education.

Level of Proficiency

It is one thing to be concerned about a new process, another to recognize needs appropriate to local classroom objectives, and quite another to acquire a level of skill mastery to effectively apply the innovation in everyday situations. Only through practice and experience can new skills be integrated into useful teaching strategies. Thus, the third dimension of the model taxonomy describes proficiency with computer-related tools in learning environments. Michael Moshell (1982) has proposed three stages:

0. **Discovery**—First encounters with the new skill. Here the teacher must decide if the new skill is potentially useful. Until the skill is valued, no further skill acquisition is indicated.
1. **Skill Building**—The learner practices using the new tool that was learned through discovery. First practice should be in the introductory session, but only through use in the classroom will the skill be mastered.
2. **Design**—Occurs after mastery of the new skill, and after enough practice to see ways of varying or improving the tool in a local environment. This could be followed by modifying the tool or creating a parallel tool. Concern Row #6—Refocusing—is related to reaching this proficiency level, which often requires programming skills.

"While progress through the taxonomy levels is a matter of personal choice, many educators will want to move to higher levels of concern, skill and proficiency. How should training be conducted to ensure teachers the opportunity to move at their own pace toward the level to which they aspire?"

Too often teachers are given no incentive to develop proficiencies beyond discovery. At the very least some release time is needed to practice application of the tool. This is facilitated by interaction with peers at the same skill level according to Hopper and Bruckhart (1982) and Wells and Bitter (1982).

Implications

The taxonomy described above is shown in Figure 1. It contains 147 cells (seven rows by seven columns by three levels). Vertical movement is in the affective domain and is accomplished by becoming increasingly aware and concerned about the implications of computers in education. Although some vertical movement may be possible without access to computer hardware, horizontal movement (through the levels of need for skills) is accomplished only through access to computers and training and requires more time and energy.

The heavy line between columns 3 and 4 indicates the transition between the use of canned software and programming. While this transition may be eased somewhat through the use of authoring languages designed for creating educational programs, it represents a substantial increase in commitment of time and energy. This distinction is not often made clear to teachers when they are introduced to computers.

Instead of trying to teach all novice teachers how to program during their first encounter with computers, a gradation of skills should be sought. Although a *discussion* of programming is appropriate for a beginning course, spanning more than one column of the skill matrix in a short time without allowing for adjustments in the level of concern will likely prove to be frustrating and unproductive for novices.

The dark line between proficiency levels 1 and 2 distinguishes between acquisition of a skill and the creative modification of existing tools for new applications. Only experience can provide the bridge between the ability to use a tool and the ability to create a better one.

All of us started out in cell 0,0,0 (low-level awareness, pre-skill, no proficiency) at some point. Most teachers are no longer in this cell, however. Many have moved through three levels of concern into cell 3,0,0 where they are seeking time to acquire initial skills but are still lacking in proficiency. A single hour of inservice might move them to cell 4,1,0 where they could understand the impact of computers on their classes, but would still lack skills. A week of experimentation on their own should permit movement into cell 5,1,1 where they might be eager to share their new skills with colleagues. A follow-up inservice could move these same teachers into cell 1,2,0 (evaluating software, wanting to discover more) and within that inservice the same teachers might move to cell

4,2,1 after initial experiences with evaluation. Time alone should move these teachers to cell 5,2,1 (evaluating and wishing to share their new-found tools with peers).

A teacher's movement (or choice of a stable resting point) within the matrix should depend on classroom needs and individual readiness. While progress through the taxonomy levels is a matter of personal choice, many educators will want to move to higher levels of concern, skill and proficiency. How should training be conducted to ensure teachers the opportunity to move at their own pace toward the level to which they aspire?

Teacher Training

It seems unlikely that departments of education can provide training for skill levels 4-6, since very few have staff with computer science backgrounds. Beyond skill level 4 (programming in the small), training should come from computer science departments, where faculty are trained in larger applications of computers and programming. Here teachers may learn to apply "programming in the large," data structures, procedural languages, algorithm design and machine language programming if they wish to practice or teach such skills.

Colleges of education probably should be given the task of training teachers in the use of "canned" educational software. They may also need to provide teachers with their first encounters in programming, simply because there are already too many students for most computer science departments to handle. Those teachers who wish to learn programming can be taught to write short programs well in any common computer language. It seems important that computer science and education departments work together, since both would gain from producing technically literate precollege students.

Teacher certification programs should address the skill and proficiency levels in the taxonomy, deciding which are desirable competencies for each grade level and end use of computers in learning environments. For example, a middle school social studies teacher may find little use for programming in Logo and may never need to cross the "programming boundary." A high school geometry teacher, on the other hand, may find programming in a graphics-enhanced language quite useful. Realizing that not all teachers need to be programmers should reduce teacher anxiety and clarify teacher training efforts.

Professional growth programs should begin with an assessment of needs and concerns of teachers. Progress can be enhanced by applying task analysis to each module of training programs and not attempting to move teachers too rapidly from one cell to other (possibly non-adjacent) cells. Some means of assessing skill levels should be established, and certification of each step provided as an incentive for those teachers whose jobs require higher skills than they currently have.

Currently very few precollege educators occupy cells beyond the middle of the matrix. One reason for the shortage of quality educational courseware is the absence of teachers at the upper ends of this taxonomy. Very few good teachers are able to author large programs of sound educational design, and too few good programmers are producing courseware to meet the needs of classroom teachers. There has also been little incentive for publishers or programmers to create good educational courseware. This points to a need for government or private funding to get good teachers on design teams with good programmers.

"Too often teachers are given no incentive to develop proficiencies beyond discovery. At the very least some release time is needed to practice application of the tool. This is facilitated by interaction with peers at the same skill level...."

Summary

A matrix of concerns, needs and proficiencies has been described as a means of clarifying the scope and sequence of teacher training in appropriate uses of computers in learning environments. "Progress" within such a matrix could even include movement from right to left on the horizontal axis, such as might occur when those with computer science backgrounds explore applications for software tools in education. The individual teacher may not follow a linear "trajectory" through the matrix. However, teachers should not start programming until they understand how to evaluate software and can use a computer to meet their own needs. This could be accomplished through supervised practice in using commercial educational software. Groups of teachers will diffuse through the matrix as an expanding front, but will generally move from left to right with greater success if entering adjacent cells than if attempting to jump across one or more columns of need for skills.

Frank and Aleta went to their inservice training session with quite different concerns and skills. Using the chart in Figure 1 as a guide, we would place Frank in cell 1,1,0—an informational level of concern, perhaps a bit resistant but ready for orientation to skill levels in his subject matter area, and not yet beyond the discovery level of proficiency. An appropriate inservice activity for Frank—and others at his level—would be an orientation to time-saving utility programs such as grade management and word processing, use of simulations and other software appropriate for his social studies students and information on available computer hardware.

Aleta would probably be placed in cell 5,4,1. Her concerns were at the level of collaboration. She was looking for better ways to use the computer based on the experience of other teachers. Her skills and needs were on the border between application and programming in the small, and her proficiency beyond a discovery level. A more appropriate inservice activity for her would be a meeting with other math teachers to review application software and share listings of programs each has written and used.

It is always easier to present a single inservice program to a large group of teachers than to deliver customized programs for smaller sub-groups based on expressed needs. However, such "shotgun" approaches to computer literacy for teachers will likely prove about as effective as telling all who stop and ask for directions to "go north six blocks and turn right." Diagnosis is at least as important to computer training as knowing the desired destination is to providing good directions. All teachers do not have the same goals, and neither do they start with the same concerns and skills.

Both Aleta and Frank would have been better off without the one-hour "briefcase expert." A long-term integrated program such as the one described by Hopper and Bruckhart (1982)[8] would utilize teachers like Aleta to help teachers like Frank grow more comfortable with computers in the classroom.

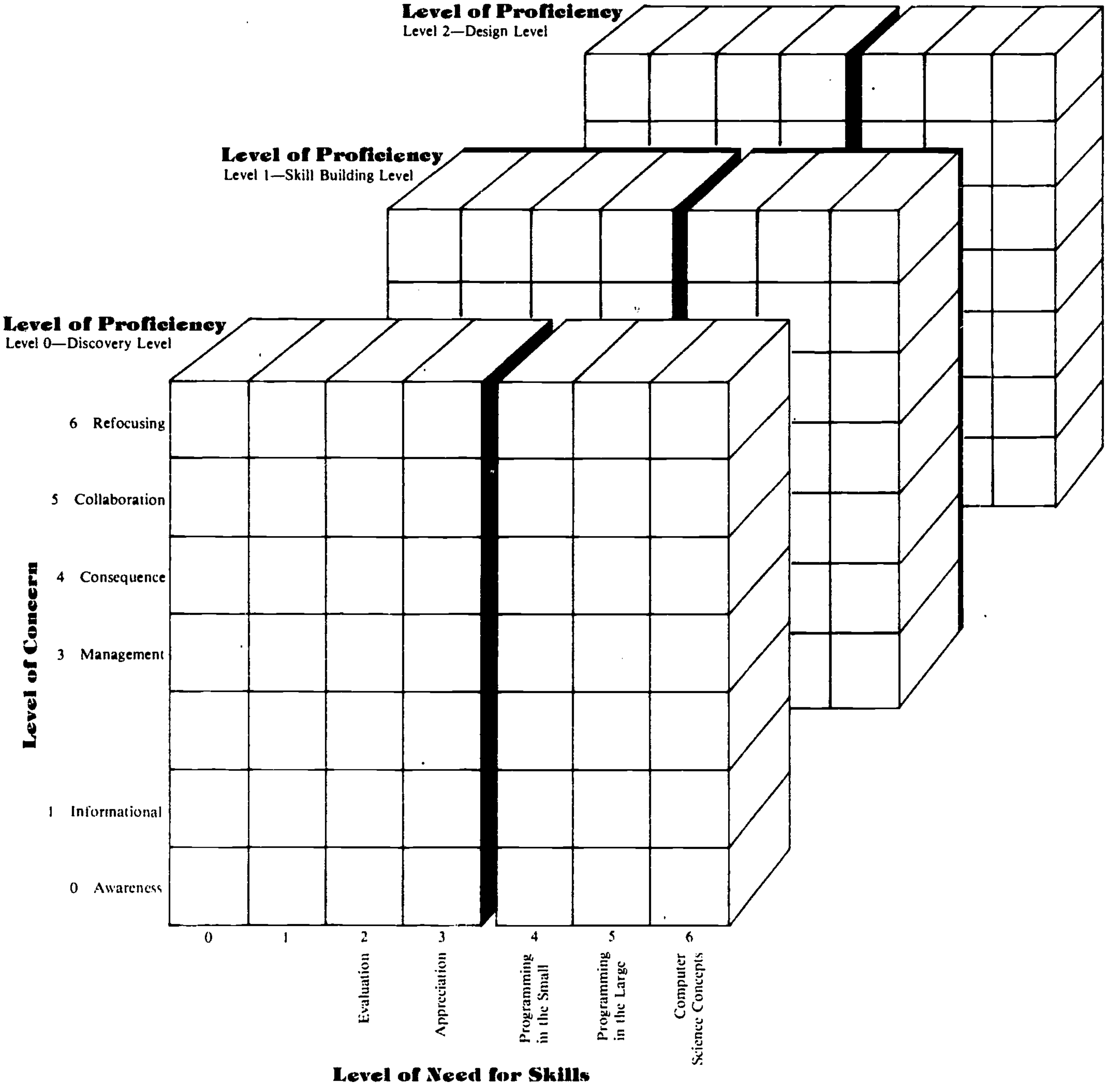


Figure 1.
Taxonomy of Level of Concern, Need for Skills and Proficiency

As we continue to chart the terrain of computer literacy for schools, we should pay attention to our destinations and use the best maps available. Administrators will be wise to remember that experienced teachers make the best guides.

This model taxonomy is offered as a starting point toward clarifying the current confusion that impedes implementation of computers in education. It will no doubt benefit from criticism, and criticism is solicited from both the computer science community and teacher training institutions.

END■

*The Hopper and Bruckhart paper describes a district's successful experiences in using the kind of training model proposed in this article. A copy of the *Proceedings of the 1982 National Educational Computing Conference* can be obtained for $15 from Diana Harris, Weeg Computing Center, University of Iowa, Iowa City, IA 52242.

[William E. Baird, Science Education Center, EDB 340, The University of Texas at Austin, Austin, TX 78712.]

[Editor's note: TCT encourages continued dialogue on this topic in the form of letters or articles.]

Sources

Gagne, Robert M. "Learnable Aspects of Human Thinking" from *The Psychology of Teaching for Thinking and Creativity*. 1980 AETS Yearbook, pp. 1-28.

Garland, Stephen J. Chairman of Development Committee for Advanced Placement Computer Science Course. Educational Testing Service. Princeton, NJ.

Griswold, Philip A. "Some Determinants of Computer Awareness Among Education Majors." *AEDS Journal*, Winter 1983, pp. 92-101.

Hall, Gene E. "Issues Related to the Implementation of Computers in Classrooms." *Journal of Computers in Mathematics and Science Teaching*. Winter 1981, pp. 14-19.

Hopper, Judith and Bruekhart, Glenn. "Computer Literacy for Teachers: A District Do-It-Yourself Kit." *Proceedings of the 1982 National Educational Computing Conference*, pp. 323-325.

Moshell, Michael and Aiken, Robert. "Computer Power." *The Computing Teacher*, 9:8, April 1982, pp. 12-14.

Moursund, David. Address to the 17th annual conference of the New York Association for Educational Data Systems. Cited in *Education Week*, November 17, 1982, p. 7 ff.

Wells, Malcolm and Bitter, Gary. "The First Step in Utilizing Computers in Education: Preparing Computer Literate Teachers." Report to the National Science Foundation, 1982, ERIC Document ED 218 703.

Zuckerman, Robert A. "Computers and Teacher Training." *AEDS Journal*, Winter 1983, pp. 123-135.

Problem Solving with Data Bases

by
Beverly Hunter

Lynn and Joey have been learning in history class about Ben Franklin's experiments with electricity. Their teacher has challenged them to find out some of the earliest inventions that used electricity.

"Let's find all the inventions made before 1900," Joey says.

"Too many," replies Lynn.

"Let's find all inventions made before 1900 that used electricity," Joey suggests.

"Yeah. But there might be a lot of them. Let's print a list."

"OK. Just print names of the inventions."

"No. We need dates to know the *earliest* inventions."

"Let's print the dates and sort them by year. Then the earliest inventions will be at the top of the list."

This problem-solving session soon produces a printed list of inventions similar to that shown in figure 1. Lynn and Joey have been using a data management program and a file of information on the subject of inventions. They use the information in the file to solve problems, identify historical trends and relationships, test hypotheses, and learn some techniques for managing information stored in computer-readable form.

What Is a Data Management Program?

The terms "data management program," "data base management system," "filing system" and "file management program" are all used to denote computer programs that enable you to design, build and use collections of information. These collections of information are called files, data files or data bases.

A file or data base is an organized collection of information on a particular subject. A telephone book, a collection of report cards, a class roster, a table of population statistics in an almanac, a library card catalog—these are all familiar kinds of files or data bases we all work with every day on paper. But these are static files—you have no control over the way in which the data are organized. Imagine trying to find all the hardware stores in your town just by using the white pages of the phone book.

A data management program makes it easy for you to use a personal computer to store, update, organize and retrieve information from data files. An important characteristic of such programs is that they are ***general-purpose*** tools. The same program can be used to create and use files on subjects as diverse as fish, student grades, cafeteria menus, countries of the world, poets, pets or paper route customers.

"The same data management program can be used to create and use files on subjects as diverse as fish, student grades, cafeteria menus, countries of the world, poets, pets or paper route customers."

INVENTIONS USING ELECTRICITY

Lightning Rod 1752
Benjamin Franklin

Electric Battery 1796
Alessandro Volta

Electromagnet 1824
Joseph Henry

Morse Code 1837
Samuel Morse

Telegraph 1844
Samuel Morse

Electric Vote Counter 1868
Thomas A. Edison

Stock Ticker 1869
Thomas A. Edison

Telephone 1876
Alexander Graham Bell

Microphone 1878
Thomas A. Edison

Incandescent Lamp (Light Bulb) 1879
Thomas A. Edison

Tabulating Machine 1884
Herman Hollerith

Radio 1896
Guglielmo Marconi

Figure 1.
Lynn and Joey's printout of inventions before 1900 that depended on electricity, sorted by year of invention.

Why Teachers and Students Use Data Bases

Here are a few examples of different purposes for using computer data bases and data management software:

- **Discovering commonalities and differences among groups of events or things.** For example, what are the differences between states that have grown rapidly in population in the past decade versus states that have declined in population? What are the common properties of gasses?
- **Analyzing relationships.** For example, is there a relationship between the distance of planets from the sun and their period of revolution?
- **Looking for trends.** Trace the patterns of change in birthrates in a specific country over the past century. Look for trends in size of households in a country and relate those trends to other demographic factors.
- **Testing and refining hypotheses.** Test the common hypothesis that "good electrical conductors are also good heat conductors" by asking the FILE program to find all the elements that meet each of these criteria separately, and then both of the criteria combined. Are the results surprising? Try a different hypothesis.
- **Organizing and sharing information.** Put the results of your library research about a U.S. president on a data file. If all members of the class store their president's information on the same file, the whole class now has one organized collection of information to use when they want to learn more about any particular president or any group of presidents.
- **Keeping lists up-to-date.** Put names, phone numbers and skills of your club members in a file. As new people join and old members leave, update the file and print out new membership lists.
- **Arranging information in more useful ways.** From a file of data about students, print out a list organized by homeroom, another list organized by bus route, and one of just the band members.

Example Files

Special terms used in talking about data bases are best learned by looking at examples. Figures 2, 3, 4 and 5 show sample portions of four different data files designed and built for students in history, government, physical science and life science. These are from a collection of 24 different files developed by Hunter and Furlong (1,2) and McLeod and Hunter (3,4). Other examples, with lesson plans, are given in *My Students Use Computers* (5).

The files are very different from one another, because each file is designed for a particular set of instructional purposes.

The Inventions file (figure 2) enables students to trace the development of inventions and technology in different fields such as agriculture, textiles, information processing, home/leisure, etc. At this time, there are about 170 different inventions in the file. Of course, students and teachers can add more inventions to the file.

All the information about one invention and its inventor, such as the hot-air balloon shown in figure 2, is on one ***record*** of the data file. In some data management programs the term used for record is ***form.*** Within each record or form there are separate ***fields*** or ***data items.*** In figure 2, the data item names are in all upper case letters. YEAR: is a field name. 1783 is the data item for YEAR.

```
                    INVENTIONS & TECHNOLOGY
INVENTION: Hot-Air Balloon
YEAR: 1783                                  TYPE: Transportation
DESCRIPTION: A lighter-than-air craft used for flight which consisted
of an impermeable bag filled with hot air.
IMPACT: Resulted in the first manned balloon flight in 1783. Hot-air
balloons are still used today for fun and sport.

                  PRESS CTRL-N TO SEE PAGE 2

INVENTOR: Joseph M. Montgolfier
BORN: 1740                DIED: 1810                      SEX: M
NATIONAL ORIGIN: France
NEED FOR INVENTION: Need for an improved balloon design.
ENABLING TECHNOLOGY:
—Leonardo da Vinci was first to speculate about flight
—Previous balloon designs
—Montgolfier got the idea of hot air after watching smoke in chimneys

            PRESS CTRL-N FOR REFS; CTRL-P FOR PAGE 1

REFERENCES:
—Encyclopedia Americana, 1980
  Vol. 3
—Collier's Encyclopedia, 1983
  Vol. 16
-----------------------------------------------------------------
NOTE: Jacques Etienne Montgolfier was co-inventor with his brother.
```

Figure 2.
Sample invention in the Inventions file.

```
                    PRESIDENTIAL ELECTIONS
YEAR: 1984
                  Political Parties and Candidates
REPUBLICAN: Ronald Reagan
  DEMOCRAT: Walter Mondale
 3RDPARTY1:
 3RDPARTY2:
                     Electoral Vote Results
REPUBLICAN: 525
  DEMOCRAT: 13
 3RDPARTY1:
 3RDPARTY2:
                     Popular Vote Results
REPUBLICAN:          53,428,357  %: 58
  DEMOCRAT:          36,930,923  %: 41
 3RDPARTY1:                      %:
 3RDPARTY2:                      %:
                                      WINNER: Reagan (R)
```

Figure 3.
Part of the election form.

All the records in one file have the same fields. The NAME of the invention, the YEAR, a TYPE descriptor, a brief paragraph DESCRIPTION of the invention, a paragraph telling the IMPACT of that invention, etc., are included for every invention in the Inventions file.

Figure 3 shows part of a record (form) for the Election file. The actual form has four times this much information in it. Data for each presidential election year since 1789 is on a separate form. The Election file is designed to encourage students to investigate trends in voter participation, development of political parties, campaign financing, campaign issues and congressional elections.

The Common Substances file (figure 4 shows part of a sample form) is designed to encourage children to investigate and become familiar with properties (such as melting point, density, color, etc.) of common substances such as ammonia, brass, chalk, coal, concrete, ice, iron, paper, sugar or wood. They use the file to solve problems such as, "Which kinds of wood will sink in alcohol, but float in water?"

PROPERTIES OF COMMON SUBSTANCES

COMMON NAME: Iron
ELEMENT, COMPOUND, OR MIXTURE: Element
DENSITY (XX.XXXX): 07.8600 (g/ml)
BOILING PT.—C (XXXX.XX): 2750.00
MELTING PT.—C (XXXX.XX): 1535.00
COLOR: Gray
ODOR: Odorless
SOLVENT (OTHER THAN WATER): Acids
SOLUBILITY IN COLD WATER—G/L (XX.XXX): Insoluble

Figure 4.
Part of the Common Substance file record for iron.

Figure 5 shows part of a sample form on the subject of animals. The Animals file is designed to encourage students to explore many different characteristics of animals—to compare and contrast similarities and differences among animals of different classes, habitats, size or food type. Students can, of course, add more animals to the file. At the present time there are 135 animals in the file covering eight classifications, with about 40 different data items for each animal. This file takes up about 60 percent of the capacity of one Apple II floppy disk.

ANIMALS

COMMON NAME: Horse
CLASS: Mammalia
SCIENTIFIC NAME: Equus caballus
WEIGHT IN KG. (XXXXXX.XX): 000453.92
LIFE SPAN IN YRS. (XXX): 035
HABITAT: Terrestrial
BIOME: Domestic
INTEGUMENT: Hair
ACTIVE ALL YEAR (Y/N): Yes
LOCOMOTION: Walking

Figure 5.
Part of the Animals file record for horse.

Stages of Learning with Data Bases

Students can develop their data management skills in three prospective stages:

Stage 1: USING — Students use data files that have been created by someone else, e.g., the files shown in figures 2-5. They use the data to test hypotheses, discover relationships, identify commonalities, look for trends, help solve problems, organize reports or investigate new subjects.

Stage 2: BUILDING — Students build a file designed for them; that is, they are provided with a form or record that has already been designed and tested by the teacher or someone else. Such a blank form is sometimes called a ***template.*** With the teacher's help, students plan the research, identify sources of information, gather data, check it for accuracy, enter the data into the computer, and then use the file in their studies.

Stage 3: DESIGNING — Students plan, design, build and use their own data files.

This progression is suggested because when you *use* a variety of data files you learn many concepts and skills that are useful later in building files. For example, recall the TYPE data item in the Inventions file. Through experience in using TYPE to retrieve information about selected types of inventions, students learn the importance of using standardized descriptors for their data. For example, if you want to look at all the Agriculture inventions, you don't want a mixture of "farming," "farms," "agriculture" and "food-growing" descriptors in the file. This concept is essential when students gather data to build their own files, because they must set up and apply a standard way of describing things for their own data bases.

Similarly, when you **build** files you learn concepts and skills needed in designing files. For example, when students gather the data for their own file they discover that different reference sources provide data in different forms. One science book might give temperature information in centigrade units, for example, while another might give the same information in Fahrenheit. Or one reference book might give populations in millions, while another provides them in hundred thousands. When designing a file, you need to first find out the form of your source data.

STAGE 1: USING DATA FILES

The following sample activities illustrate a sequence in which students become increasingly more proficient in their use of a data file, as well as becoming increasingly more familiar with a particular subject they're studying in history class. The example activities are based on the Inventions file mentioned earlier. Students use this file with the data management program called *PFS:FILE* (Software Publishing Company). However, the instructional purposes and scope and sequence of activities are applicable to the use of any data management program suitable for children.

Activity 1: Exploring a Data Base

When students (or people in general) start to use a data file that is new to them, the first thing they need to do is to explore the file—to discover what data are in the file and how the data are organized. This is similar to the way you might flip through a new textbook to see what topics are covered and how the material is organized. The specific techniques for doing this exploring on the computer depend on the data management software program you are using, how familiar the students already are with the subject matter, and how familiar the students already are with the data management program.

Activity 1 assumes students know very little about the subject matter and nothing about how to use the data management program. Students are taught to ***browse*** through a data base that is new to them. As they browse, point out various features of the data base, and have them take notes on certain facts and ideas that they notice. For example, the Inventions file has a data item called TYPE—have students take notes on the different TYPEs of inventions they see as they browse (agriculture, textiles, communications, etc.).

During this "exploring" activity, explain any new terms and concepts. For example, the Inventions file (figure 2) contains a data item called ENABLING TECHNOLOGY. It can be explained in this way: When a person invents something, s/he depends on other existing inventions. For example, you couldn't invent a wagon if wheels hadn't already been invented. The fact that you already have wheels ***enables*** you to invent the wagon. Wheels are an "enabling technology" for the invention of the wagon.

This exploring activity can be introduced in different ways. One way is for the teacher to demonstrate the exploration to the whole class or a small group. Throughout the demonstration there can be class discussion to ensure that all students understand the concepts and terms used in the file. Another way is to have students work in pairs at the computer. Prepared written lessons may be helpful for students to follow as they do their exploring on the computer. As they go through the lessons they can be instructed to take notes on some of their observations.

Activity 2: Asking Questions

After students are somewhat familiar with the content and organization of the data file, teach them how to use the data and the data management program to answer questions. The exact details depend upon the particular data management program used, and the way the particular data file is organized.

Begin by asking a question you're pretty sure students are familiar with, or have already been studying in class. For example, using the Inventions file, you can begin by asking students to discover Thomas Edison's inventions. Using the *PFS:FILE* program this is a very simple task: With the blank form on the screen, you simply type "..Edison" beside INVENTOR:. The .. before Edison is a way of avoiding the question of how to spell his first name or whether he has a middle initial. As soon as you type "..Edison" and press a key that tells the program to continue, one of Edison's inventions appears on the screen.

As this activity continues, ask progressively more sophisticated questions; that is, questions that require either more complex retrieval techniques or more complex interpretations from the data. For example, help students to narrow their search to focus on important inventions in the textile industry in the 18th century. (Find all textile TYPE inventions invented between 1700 and 1800.)

Above all, encourage students to experiment, to try things out, to discover limitations of the data base, to find questions that will stump their partner.

"There are some advantages to having only one or two computers available for the class—students waiting to use the computer have more time to plan and document their approach to solving the problem."

Activity 3: Defining Your Information Needs

After students are familiar with the data base and know how to retrieve selected information from it, they can learn to apply these skills in solving problems. The purpose of Activity 3 is to get students to define the information they will need in order to answer a question or solve a problem. Try to word the problem statement in such a manner that there is no single "right" way to go about solving it. For example, students might be asked to identify a single invention or group of inventions that make possible today's instantaneous worldwide communications capabilities, and to provide data to support their argument. There are many ways to go about analyzing this question using the Inventions data base. Some students may use the information on impact of inventions, while others may look for enabling technologies that are common to many recent communications inventions.

Encourage students to break the problem down into smaller problems or questions, and write the questions in their own words.

Students can work in pairs at their desks as they plan the information needed to answer the question. There are some advantages to having only one or two computers available for the class—students waiting to use the computer have more time to plan and document their approach to solving the problem.

Worksheets are beneficial in helping students plan the information they will get from the file to help answer the question or solve the problem. They need to decide how they will search for the particular data needed, what data items from the file should be printed out, what order the list of data should be printed in, and other details about the formatting of the list.

After students have planned their printouts, they can go to the computer and use the data management program to get the data they have planned.

Activity 4: Interpreting and Debugging

Whether you're a fifth grader studying history, an economist working for the Federal Reserve Board, or a businessperson making a business decision, *you never get exactly the right information you need to solve a problem in your first attempt.* In Activity 4, students examine the printout of information they have obtained to analyze how well it helps them answer their question or solve their problem.

"Whether you're a fifth grader studying history or an economist working for the Federal Reserve Board, you never get exactly the right information you need to solve a problem in your first attempt."

Figure 6 shows one student's first attempt at getting a printout of information to help answer the question about communications inventions. It very nicely lists communications inventions in order by year. However, it doesn't provide the information needed on either the impact of the inventions or the enabling technologies. The student minimally needs the information about the IMPACT: of the invention in order to understand how a particular invention affected our ability to communicate.

Again students can work in pairs at their desks, interpreting their printouts and trying to use the information to answer their questions. Usually they need to go back and get at least one more printout before they have what they need. Figure 7 shows a second attempt, this time including the information about impact of the inventions.

Encourage students to continue analyzing their printouts and gathering more information until they are able to interpret the data in a way that enables them to answer the question or refine their original hypothesis.

Activity 5: Updating the File

A wonderful characteristic of computerized data files is their updatability. Unlike a textbook, reference book or other printed material, a computer data file is very easily modified to suit your particular needs. For example, suppose you want your students to learn more about inventions related to use of energy sources such as coal, oil, solar, wind or atomic energy. Students can research inventions such as the waterwheel, turbine generator, windmill, solar furnace, nuclear reactor, etc. Each pair of students can gather information on one invention and add the data to the Inventions file. The whole class then has a richer collection of information on energy-related inventions to use in their studies.

Activity 6: Projects

After students have been led step-by-step through the first five activities, they should be ready to proceed on their own to use the file for a project. Ideally their project will result in a useful product for other students, the school or neighborhood community. Here are some example student projects using the Inventions file:

1. Prepare a chronological list of inventions in a subject area such as Information Processing or Agriculture. Show the enabling technology for the inventions on your printout. Analyze the relationships between the enabling technologies and the inventions they made possible.
2. Impact of inventions. Prepare a chronological list of inventions of a particular TYPE such as home/leisure or transportation. Include in your list the IMPACT data. Then interview some older people (the older the better), and ask them for their opinion as to how these inventions changed their lives or the lives of others. Can you summarize this information by selecting three inventions that have had the greatest impact on people or society?
3. Inventors. Prepare a list of inventors, grouped by nationality. Do you see any patterns in the types of inventions made by people from a certain nation? Do you see any patterns in the dates of the inventions that came from certain countries?
4. The effects of war. Find out the years of wars such as World War I or World War II. Look at the inventions made during those periods. Did the wars affect the kinds of inventions made?
5. Clustering of inventions. Examine a chronological list of inventions. Do you see any periods of time when there were a lot of inventions or a collection of related inventions? Find out more about those periods of history and see whether you can find a reason for this. Is it related to the enabling technology that was present?

COMMUNICATIONS INVENTIONS

YEAR	INVENTION
0105	Paper
1450	Printing Press
1796	Electric Battery
1824	Electromagnet
1826	Braille
	Photography
1837	Morse Code
1844	Telegraph
1867	Typewriter
1868	Electric Vote Counter
1869	Stock Ticker
1876	Telephone
1878	Microphone
1894	Motion Pictures
1896	Radio
1904	Vacuum Tube
1923	Television
1937	Xerography
1948	Transistor
1956	Videotape Recorder
1962	Satellite Communications

Figure 6.
Student's first attempt at getting information to answer the communications question.

COMMUNICATIONS INVENTIONS

YEAR	INVENTION	IMPACT
1876	Telephone	Allowed for a global network to convey sound. Local, long-distance and overseas telephones reach 96% of the places in the world.
1878	Microphone	The microphone is the foundation for much of the audio communication field. It is still used widely today.
1894	Motion Pictures	After refinements, led to the motion picture or movie industry.
1896	Radio	Made it possible for the first time to communicate a message instantly to thousands or millions of people at the same time, over long distances.
1904	Vacuum Tube	The vacuum tube was the foundation for electronics for 40 years. It has been almost completely replaced by the transistor, except in certain special-purpose applications, such as picture tubes in TVs.
1923	Television	Made it possible for the first time to communicate pictures and scenes to thousands or millions of people. Most effective means of communication ever devised—"the eyes and ears of the world." Force for education, enculturation, political persuasion and merchandising.
1937	Xerography	First xerographic copier was marketed by the Xerox Corporation in 1960 and has since grown at an astonishing rate. Completely replaced the need for retyping a document, thus saving time and labor.
1948	Transistor	It has supplanted the vacuum tube in electronic equipment. Transistors are used in radios, TVs, computers, hearing aids, etc. They revolutionized the development of the computer.
1956	Videotape Recorder	Provides good storage of program material and an advantage over film. Used extensively to tape programs for rebroadcasting later. Also used for instant replay.
1962	Satellite Communications	Communication satellites provide a major part of the world's global communications. They allow instantaneous transmittal of information and pictures.

Figure 7.
Second attempt at getting communications information.

6. Prepare a list of inventions that improved travel by land. What is the most recent invention in the file related to land travel?
7. Trace the development of guns over time. What was the first gun invented and when? Show that guns have become more powerful over time.
8. Many inventions became possible only after people learned how to turn oil into products such as gasoline and diesel fuel. Which inventions depended on oil refining and when were they invented?
9. What inventions contributed to the early Industrial Revolution in England in the 18th century?
10. In what ways did the invention of the steam engine and the refrigerator change the ways we prepare, distribute and use food?

Starting from Square 1

by
Norma C. Piper

What do you do when the principal puts a computer in your classroom? One computer, thirty 5th and 6th grade students, and no experience? Don't panic! There's a way out. Here are some do's and don'ts to help you.

First, buy a manual. I found *Creative Programming for Young Minds* by Leonard Storm[1] and *Kids and The Apple* by Edward Carlson[2] to be excellent. Each book is organized in lessons that are easy to follow and are ideal for classroom use. Don't depend on prepared software for your entire computer literacy unit. It is important to teach your students how to program. The interaction with the computer in doing even simple programming helps increase students' confidence and enhance self-esteem. A child learns by doing, and even young children can learn to program. They certainly do not write "professional" programs, but they do write programs that solve problems at their level.

I divided my days into eight half-hour periods:

	M	T	W	Th	F
8:30-9	T	T	T	T	T
9-9:30	1	8	15	5	T
9:30-10	2	9	16	6	12
10:30-11	3	10	17	7	13
11-11:30	4	11	1	8	14
11:30-12	5	12	2	9	15
1-1:30	6	13	3	10	16
1:30-2	7	14	4	11	17

This schedule provides 40 blocks of computer time every week for my class of 34 students. Each student is paired with a partner to make 17 groups. Each group is assigned two computer blocks per week. The other six blocks are reserved for me (T).

I use my blocks of time for computer programming instruction, for introduction of new software, or for individual students to save a new program on a disk.

My reserved blocks on Friday are especially helpful. If a few students miss their computer time earlier in the week due to an assembly or testing, they can move their time to Friday.

Students work together at the computer, one programming and the other editing, for fifteen minutes and then change places. When their time is up, the next scheduled group lets them know. If they are in the middle of typing in a long program, they can save it on a cassette tape or disk. The more experienced computer operators are available tutors.

"A word of caution ... don't make the use of the computer a reward for finishing math or for good behavior. The computer is a tool for all students and should be treated accordingly."

A small paperback book called *Basic Fun* by Lipscomb and Zuanich[3] has some simple game programs that teach the use of computer language. My students have expanded these programs and have gone on to write some of their own.

A word of caution . . . don't make the use of the computer a reward for finishing math or for good behavior. The computer is a tool for all students and should be treated accordingly. All children should be able to count on computer time each week. *You* will reap the reward. END■

[Norma C. Piper, 5th/6th GATE Teacher, Covina-Valley Unified School District, P.O. Box 269, Covina, CA 91723.]

Bibliography

1. Storm, Leonard. *Creative Programming for Young Minds.* Creative Programming, Inc. Charleston, IL 61920.
2. Carlson, Edward H. *Kids and the Apple.* Datamost, Chatsworth, CA 91311.
3. Lipscomb and Zuanich. *Basic Fun.* Avon Books, New York, NY 10019.