lem right, the clown smiles; if he gets it wrong, the computer makes a bronx cheer. Cute, huh?"

"Uh, well . . . don't you have anything a bit more challenging?"

"Oh, definitely. Our new version of *Math Drill* will be ready in just a year. Of course, then it will run only on our new Lemon V with 64K."

"64K?"

"Yeah. The Lemon IV has only 48K. 'Course, it's a terrific machine and now's a great time to buy. We can offer a super deal for your school on the Lemon IV."

"How much do they cost?"

"Like I said, the Lemon IV is a great deal right now. We group them in units of ten. We call it a Lemon Tree. When you turn on a Lemon, it plays a little tune: 'Lemon tree, very pretty. . . .' Cute, huh.' Let's see: ten Lemons at $999 is ten thousand. Then you'll need the disk drives, the data cassettes, and ten monitors. A mere $25,000 should cover it. And of course, we throw in the software for free. Now that's a real bonus. You get ten copies of our math drill, a $500 value."

"Can't we just get one copy of ten programs and duplicate them?"

"Oh, no, Mr. Blankenship. That would be illegal."

"So we'd need to pay $500 for every new program?"

"You have no idea how expensive development is. The cost is just enormous. Five hundred dollars is not such a high price for what you're getting."

"But for what I'd pay for a few programs, I could hire a special teacher, buy a computer, and just have a demonstration class."

"Ah, but the hands-on experience in problem-solving techniques is fantastic. You can't deny that to your students. Of course, you should have a few rules in your computer classroom. We advise: no food, no drinks, no chewing gum. Also, you should make sure there are no game programs around."

"Is that all?"

"Well, a controlled environment helps. You'll also need a service contract for your machines, especially for your disk drives."

"This all sounds rather complicated."

"Oh, gee, no. The kids will have it figured out in no time at all. In fact, we've found that many go out and buy their very own Lemons after they've used them at school. They practically teach themselves."

"Can we write our own programs?"

"Surely! We offer a free two-hour seminar on programming for the new computer teacher, and a simplified macro-assembler course for the more advanced teachers."

"Macro-assembler?"

"You bet. And next year we'll even have a macro-assembler debug tool out for the programming support on the Lemon IV."

"Uh, great."

"I've got a machine set up outside. Would you like to see a little demo? Your secretary has been playing *Zzzaapppoo*."

"What do I do?"

"It's real easy. Just turn on the monitor here, then insert this disk in the slot. Close the little door. Turn on this switch, and that little light means the disk is working. See?"

"It stopped. Are we ready?"

"No, you booted the DOS."

"DOS?"

"The disk operating system. Now we're ready to load the program—*Addition Drill*. See the clown? Wasn't I right—isn't he cute? You know, both Washington and Lincoln Highs will have their own Lemon Trees this semester."

"I guess if the students will see them in high school, we'd better get them."

"Right you are, Mr. Blankenship. You know, it's a real pleasure for me to get to work with such an innovative educator as yourself."

"Yes, well, I was the first in my district to have instructional television. . . ."□

Cars, Computers, and Curriculum

The computer may be today's darling, but its value for tomorrow has yet to be tested.

CHARLES SUHOR

In 1900 an enthusiastic futurist might have made some predictions about society and education as follows:

By 1950 the automobile will influence every aspect of our lives. Those who have no knowledge of the automobile will be at a serious disadvantage in their personal, social, and vocational lives. Every household will have one (or even two!) cars. Vast industries of auto production, sales, and maintenance will grow. The automobile will enable individuals to live at ever greater distances from their places of employment, as "commuters" simply jump into their cars each morning, drive at speeds up to 40 miles an hour, and return by the same routes on an expanded network of macadamized roads.

Moreover, new vistas of recreation will be open to families. Advanced technology and mass production will make cars affordable to the average American family. We can look forward to driver-friendly devices (no-crank ignitions, automatic chokes and transmissions) that will breakdown resistance to car use in our society.

But pity the poor midcentury citizen who lacks fundamental knowledge of the automobile. Such a person will be stymied by the overheating of a radiator, the deflation of a tire, or the simplest unplugging of a wire in the car's complex electronic circuitry. People who are knowledgeable about the basic workings of the automobile will have incalculable advantages over "auto-illiterates." The car-wise individual will arive on time, make more professional contacts, and engage in sparkling conversation about radiators and batteries. The non-driver and non-car owner will be ill-suited to successful 20th century living.

The implications of the automobile for education are mindboggling. And yet it is clear that our schools are not

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preparing students for the world in which they will live. This is especially ironic, because young people seem to have a natural affinity toward cars, far outstripping their parents in open-mindedness and eagerness to learn. The curriculum must be drastically overhauled to serve the new, car-rich environment.

Here are some moves that must be implemented immediately: mandatory courses in car maintenance and repair, beginning in the seventh grade or earlier; driving and safety courses as prerequisites to high school graduation; in reading programs, emphasis on rapid decoding of street signs, traffic markers, and a variety of direction-giving devices; in mathematics, emphasis on auto economics—calculation of miles between communities, miles per gallon, and cost of auto upkeep; in the sciences, on the complex principles of physics and chemistry involved in the workings of automobiles.

Beyond general education, our professional and vocational programs must be developed to furnish a virtual army of lawyers, engineers, insurance specialists, police officers, mechanics, salespeople, and others with the intensive knowledge required in an auto-dominated society. In short, schools will either immerse themselves in car consciousness to meet the demands of the new society, or they will lapse into irrelevance.

Yes, I've tossed in some obvious anachronisms and exploited hindsight with considerable license. But a 1900 Nostradamus would have been very reasonable in advancing such ideas about schools, automobiles, and social change.

Reasonable, but only partly right. Schools *might* have been pushed in those directions, but somehow they took a different perspective on the automobile, dealing with its revolutionary social effects without recasting the K–12 curriculum. I suspect that a similar situation will evolve with regard to computers, despite the glibness of many current predictions about their effects on education.

I tucked some tongue-in-cheek allusions to computers into my narrative about cars, but let me spell out four caveats that are implicit in the car/computer metaphor.

1. *The presence of a powerful influence in society at large need not result in massive curricular change and school reorganization.* If this principle were not true, school buildings would be totally obsolete, replaced in the early 1900s by telephone instruction, in the 1930s by learningmobiles, and in the 1950s by study-by-television. We are mindful of seminal events of the past—such as invention of the Greek phonetic alphabet and invention of the printing press—that have had revolutionary, long-range effects on education (Havelock, 1976; McLuhan, 1966). But where is it written (except in Delphic futuristic fantasies) that society's innumerable forms and institutions—from military budgets to inane sitcoms to new electronic offices—must have proportionate correlates in the schools? Tell me all about interactive, two-way computer-driven cable TV, about database systems and random access. But don't tell me that schools will trail hopelessly behind the rest of society if we don't redesign the curriculum by next summer.

2. *An important new medium in society is not necessarily an important teaching tool.* A refinement of the first caveat, maybe, but a necessary one. The lamentable state-of-the-art of computer courseware and the expense of developing high quality materials (Bell, 1980; Fech, 1982) are immediate arguments against prematurely placing our faith (and our money) in advanced technologies.

The very concept of computers as *advanced* educational technology is called to question by Weizenbaum's (1976) observation that the algorithmic, binary nature of computer generation invites (but does not compel) development of mastery-based, drill-and-practice materials drawn from Skinnerian models of learning processes. The bias towards a linear model of thinking discourages development of more complex and challenging materials that deal with higher cognitive abilities.

This technical quirk hides a deeper question about human values and professional priorities: *should* the development of higher thinking skills be sought primarily through computers? In recent years we have learned much about cognitive processes embedded in and developed through oral and written language (Kroll and Vann, 1981; Staton, in press; Thaiss, in press). With such exciting resources for direct, eye-to-eye development of human potential, we should wonder mightily about a medium that is fundamentally asocial, tending to isolate learners from peers and teachers.

The computer has other limitations that are seldom taken into account by enthusiasts. For physiological and psychological reasons, a 40-character, 34-line television monitor is a poor medium for what Brown (1979) calls "deep reading." True, a user can gain quick access to various parts of a lengthy text. But the fact is that complex texts—those requiring concentrated attention and high-level synthetic reasoning—are rarely found either in commercial software packages or in external database resources. The computer as a medium is well-suited to information aggregates—stock market reports, recipe collections, short news items, and the like—not to extended prose fiction or analytical essays.

3. *Bandwagons break down; student fads are mortal.* You'd think we would have learned this lesson, having survived every manner of hustle, and faced with new hat tricks with names like the "Paideia Proposal." It is not reactionary to point out that the current computer rage has the familiar earmarks of an overpublicized educational hype: claims of efficacy that exceed research data, endorsement by the federal government, coverage *ad nauseum* by mass media, a new focus for big spending, and feverish attempts to "get with it" in the educational community.

As for students taking to computers rapturously and in large numbers, I recall the same rationale for TV in the classroom in the 1960s. Moreover, evidence of children's "natural" enchantment with computer programming is largely anecdotal and certainly hyperbolic. I have heard such stories mainly about children of MIT professors, and from parents who recently sank several thousand dollars into personal computers and a truckload of peripherals and software. By and large, computer interest among youth is centered on the neighborhood arcade—and even there, the thrill is on the wane (Wanner, 1982).

4. *"Computer literacy" is not an extension of general literacy.* Have you ever noticed that people who want to champion a cause often link onto the word "literacy"—as in visual literacy, global literacy, scientific literacy, computer literacy, and what-have-you literacy? The device is raw propaganda, and does no service to reading and writing (which must now, it seems, be redundantly called "print literacy"). Greenlaw (1976) and Morrow and Suid (1974) have asked hard questions about slippery verbalizations like "visual literacy." Similarly, we must ask, *What do computers really have to do with literacy?*

Computers have a great deal to do with general mathematics, and LOGO (Papert, 1980) shows promise for teaching geometry and physics in new ways. But outside of word processing, certain

experimental composition teaching techniques (Bradley, 1982; D. Suhor, 1982) and some interesting forays into reading based on schema theory (Schank, 1982)—a slim part of the computer movement in education—there is little in the movement that advances traditional literacy.

Computer jargon falsely suggests the creation of rich language environments. For example, many software materials are called "interactive." But the wholesome label most often points to simple-minded computer reasons like "Try again, Johnny!" It is precisely in the area of language and literacy skills that a research basis for the power of the computer in education is weakest.

Recently I examined dozens of prophecies about computers in education in light of the known capacities of computers as educational tools—especially, as tools for development of literacy skills (C. Suhor, in press). The predictions are wildly optimistic. Of course, they *might* come true. But the most interesting point about those statements that begin "by 1900 . . ." is that they are usually made by industrialists, materials developers, and others with a vested interest in new technologies.

I don't blame them for making such predictions, any more than I would have blamed Henry Ford (who debunked history, not prognostication) for predicting wonderful things for the automobile when he set up his first assembly line in 1913. The only prophecy worth making, I believe, is the self-fulfilling one, in which you predict with gusto and then work strenuously to make your predictions come true.

But such predictions should be given hard analysis and balanced by aggressive counterpredictions. The hard analysis will come, because educational movements operate according to a hulking dialectic in which no thesis ultimately escapes critique. As for counterpredictions, here are a few: I predict that educators will look industrial gift horses in the mouth. I predict that the educational technology that dazzles us today will be put to numerous tests of research, and weighed against traditional technologies and methods—the spoken word, for example—which will prove more "user friendly" than a joy stick. I predict that language arts computer materials will be produced with the learner's language growth in mind—no–nonsense materials that use graphics organically, not as gimmicks. I predict that easy phrases like computer literacy, computer languages, and interactive software will be deflated by simple semantic analysis, by sheer overuse, and by the disillusionment of those who come to know the actual range of human experiences covered by such terms. Finally, I invite researchers, administrators, and teachers to contribute toward the fulfillment of these predictions.□

References

Bell, Kathleen. "The Computer and the English Classroom." *English Journal* 69 (1980): 88–90.

Bradley, Virginia. "Improving Students' Writing with Microcomputers." *Language Arts* 59 (1982): 732–743.

Brown, Roger. "The Three *Moonrakers*: An Inquiry Into the Potentials of Different Media." Address before the NCTE Annual Convention, San Francisco, November 1979. NCTE Audiocassette 73004. Urbana, Ill.: National Council of Teachers of English, 1979.

Fech, Bruce. "Computer-Assisted Reading Instruction: Beyond Drill and Practice." Paper presented at the International Reading Association Convention, Chicago, April 1982.

Greenlaw, M. Jean. "Visual Literacy and Reading Instruction." *Language Arts* 53 (1976): 786–790.

Havelock, Eric. *Origins of Western Literacy*. Toronto: Ontario Institute for Studies in Education, 1976.

Kroll, Barry, and Vann, R. *Exploring Speaking-Writing Relationships*. Urbana, Ill.: National Council of Teachers of English, 1981.

McLuhan, Marshall. *Understanding Media*. New York: McGraw-Hill, 1966.

Morrow, James, and Suid, M. "Media in the English Classroom: Some Pedagogical Issues." *English Journal* 63 (1974): 37–44.

Papert, Seymour. *Mindstorms*. New York: Basic Books, 1980.

Schank, Roger. *Reading and Understanding: Teaching from the Perspective of Artificial Intelligence*. Hillsdale, N.J.: Erlbaum, 1982.

Staton, Jana. "Thinking Together: Language Interaction in Children's Reasoning." Washington, D.C.: U.S. Department of Education, in press.

Suhor, Charles. "The Role of Print as a Medium in our Society." In *Becoming Readers in a Complex Society*. Edited by O. Niles and A. Purves. 1984 Yearbook, National Society for the Study of Education, in press.

Suhor, Deborah L. "Program Design for Movable Modifiers." Unpublished paper, University of Illinois, Department of Secondary Education, 1982.

Thaiss, Christopher. "Learning Better, Learning More: In Home and Across the Curriculum." Washington, D.C.: U.S. Department of Education, in press.

Wanner, Eric. "The Electric Boogeyman." *Psychology Today* 16 (1982): 8–11.

Weizenbaum, Joseph. *Computer Power and Human Reasoning*. San Francisco: W. H. Freeman, 1976.

Computer Literacy

In the Alexandria, Virginia, schools, computer literacy has become as basic as reading, writing, and arithmetic.

DONALD E. DEARBORN

Recognizing that the explosion of computers in society has made computer literacy as essential as the basic skills of reading, writing, and arithmetic, the Alexandria City Public Schools in Virginia are going all-out to make their students and teachers computer literate. During the 1981-82 school year, Alexandria was one of three school systems in the country to pilot a K-8 computer literacy program developed by the HumRRO Corporation. The program calls for use of computers in language arts, mathematics, science, and social studies so that students are ultimately able to use the computer (1) as a tool in the instructional process, (2) to solve problems, and (3) in writing through word processing.

Problem solving and logical thinking are key components of the Alexandria program, which has four strands: history, concepts, process, and applications. Figure 1 shows activities covered at each grade level. Students in the fourth grade, for example, receive hands-on experiences in the "concepts" strand. Even kindergarten students are taught basic computer parts.

The district meets the equipment needs of this program through two laboratories, each containing 24 microcom-

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