

Via Technology to a New Era in Education

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The second in a series of
perspectives on employing
technology to solve the
pressing problems of society.

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The 1970's may be remembered as the decade when mounting evidence made it impossible to ignore potential disasters in the areas of energy, food, natural resources, education and other concerns of worldwide dimension.

Possibly, it could also be the decade that will be remembered as the time when appropriate tools were resolutely put to work to solve those serious problems.

Technology is one word for those tools. In this series of papers, William C. Norris, chairman of Control Data, reflects on how to find, develop and apply technology and its many implications in our society.

Via Technology to a New Era in Education

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Without a doubt, the people of this nation know more today than any other people at any time in history. Yet there seems good reason to believe that the more we know the less we understand — that the greater and more complex and more pressing our national problems, the less we seem able to reach timely agreement on solutions. Take energy as an example. In spite of a desperate need for a national energy policy, our country continues to drift without one. Health care, unemployment, housing, or crime are equally valid examples.

Education, of course, has become another well-recognized national problem. Of all those I have named, it is the one about which there is the most reason for optimism.

The steady, steep rise in the cost of education — to the point of bankrupting one school administration after another — has received only fragmented efforts at solution. Indeed, fragmentation is at the very root of the cost problem in education, and can be blamed for the mounting quality complaints as well.

One manifestation is the horrendous duplication of effort, as each teacher continually reinvents the wheel in his or her own classroom. The prerogative of each teacher to decide what is best has resulted in only isolated applications of advanced technology in education. Very little has been accomplished in focusing subject matter, teaching experts, and technology on common objectives. Teachers are not solely to blame, because college presidents, boards of trustees, public school boards, and even communities all maintain their educational prerogatives and their outdated labor-intensive ways.

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But I believe it is increasingly evident that there is one segment in our society that can cut across these narrow, autocratic domains: private, competitive enterprise. Corporations must be, and I believe want to be, more concerned with meeting the needs of society; and the number one need, after jobs, is higher-quality, more readily available education — at a lower cost.

The most direct and effective way to get it is for private companies to provide the appropriate technologies, management, marketing, and leadership to glue together enough governmental and institutional support to provide a better alternative. The primary technological alternative is CBE, computer-based education, in a learning center network.

The past 30 years or so have produced a base of advancing technologies that have the power to revolutionize the quality, productivity, and availability of education.

The technologies to apply are the electronic ones — television, radio, audio and videotapes and discs, computers, computer conferencing,

cable TV, microwave and satellite transmissions, and of course CBE.

Some of those technologies have been applied individually – some with high success, others with less, but each contributing enough useful experience so that today we can begin to glimpse the education system of the future.

THE SYSTEM

The procedure seems clear. We must assemble and configure our several technologies into a system that does what the present educational process does, but does it with capital-intensive, productive technologies, rather than trying to drive still harder a labor-intensive process that can at best only stagger under the loads of higher needs, higher expectations, and higher and higher costs.

The type of system that looks most workable is basically a national and international network of learning centers. In the U.S., for example, there will be a number of independently owned networks – in some respects not unlike the TV networks of today. On a local basis, such as within Washington, D.C., this would probably include the use of cable television and microwave. On a national and international basis, satellite communication will be involved.

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The system is computer-controlled and the main method of delivery is computer-aided instruction with integrated terminal subsystems which include videodiscs, audio input and output, and touch input. Structured computer conferences of up to 40 students can be held, or a single student can interact with another student or instructor as desired. The key to this system will be computer-aided and computer-managed instruction, but other types of media will be offered as appropriate.

The PLATO system of CBE is at first glance perceived as having several advantages: infinite patience, the epitome of personalization, nearly limitless versatility, and delivery of uniformly high quality. But it's much more than that. It's a knowledge, fact, information, and educational delivery system of the first order, using many media and structures. It offers the promise of profound and beneficial impact on the delivery and application of knowledge in ways that free us from the fetters of an educational process virtually unchanged from the days of its great namesake teacher, Plato.

It is applicable to an information-based or knowledge-based service involving exchange of facts and/or their modification. It can be used

one-to-one, like a telephone, or one-to-many, like radio or TV. But in addition many can interact with the one or interface with many others. With audio and visual, it is a communication system with a virtually inexhaustible memory and the ability to exercise agreed-upon logic. It is profound, transportable, lasting, dependable. It works 24 hours a day, seven days a week. It costs less and less each generation. And it can be consistently excellent.

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HOW TO PROCEED

The learning center networks I spoke of will arise from the cooperative efforts of business, government, and educational institutions. Perhaps multinational companies will fashion and operate the networks. A network will "retail" education to the user through learning centers or "wholesale" it to other educational institutions.

A wide range of courseware will be offered. If you are not familiar with the term "courseware," you could think of it as curriculum materials in all media forms, including computer programs. The courseware must be of the highest quality. Cooperative efforts between the networks and either individual authors or author teams, as well as cooperative projects with educational institutions worldwide, will insure that quality is achieved. No one should underestimate the cost of high-quality courseware. The investment in individual courses will be up to \$1 million or more for each network. Therefore the ability to deliver to a large segment of the population is necessary to insure a reasonable return on this investment.

COMPUTER ASSISTED INSTRUCTION (CAI) TIMETABLE

Training for Industry. The market entry point for the learning center network is to provide training for industry. The most urgent need in industry today is productive improvement. Employee training is the area with the most potential, and CAI has reached the stage of development where it is cost-effective for many types of employee training. One reason is that employee time in training is a definable cost to a company. CAI has demonstrated already that it saves time and improves learning. Additional savings will appear as the costs of components of advanced technology are reduced further by development. Within a few years, training will become available in many communities through portable terminals used in the home.

Expenditures for training in industry in the U.S. are estimated at \$100 billion annually, which is about the same as the combined cost for primary, secondary, and college education. Thus there is a market

sufficient to support a national network of learning centers delivering training to industry. In fact, the Control Data Corporation already has a national network in operation with 26 centers, and more are planned.

Special Education. The next area where CAI will become cost-effective is in special education, which today is very costly. It is also highly frustrating and time-consuming for teachers. The individual testing, prescribing, feedback, record keeping, and analyzing – all done manually – require too much time, effort, and patience to be done effectively. The computer has infinite patience. It doesn't neglect any of those chores in favor of something more interesting. And it is private. The pacing factor in getting widespread usage is availability of courseware. But special education has a high priority with the U.S. government, and substantial resources are being committed to this area.

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Vocational Training. CAI will become cost-effective for those areas of vocational training where simulation can replace hands-on experience within the next year or two. Examples are training for the maintenance of TV sets, instruments, computers, and many types of mechanical devices.

College. Use of CAI will become widespread in colleges over the next five years as costs of traditional education rise and CAI costs decrease. Department of Health, Education and Welfare figures show that traditional instruction costs have been increasing at an average compounded rate of about 8.2%. In the last three years the figure is 13%. On the other hand, costs of the technologies for CAI are decreasing by about 5% per year, coupled with a 10% improvement in performance.

A considerable amount of courseware for PLATO CAI, developed by the University of Illinois, is now available. Several other universities have recently begun to use PLATO and are developing college-level courseware. Florida State University is one. At the University of Quebec in Canada, courses are being developed for use in French-speaking countries.

Thus it is none too soon for colleges to start using CAI on a pilot basis in order to prepare to take full advantage of CAI's potential.

Continuing Education. Continuing education is another area where we should begin pilot operations. Because of the rapid generation of new knowledge, CAI is particularly advantageous in this area. The new methods will bring young and old together in learning centers.

Primary and Secondary Education. Cost-effectiveness in secondary and primary education will occur last of all, yet CAI has important advan-

tages that make it desirable to begin in a modest way immediately. Our limited experience strongly indicates that many underachievers can be stimulated to reach their potential performance levels by participating in just one CAI course. Certainly this sort of result is a bargain, even at present cost levels.

Developing Countries. An international learning network also offers very great advantages to developing countries. Introduction will be paced by availability of satellite communication, but once it is available, rapid progress can be made in surmounting the chief obstacle: a shortage of teachers and administrators. Meanwhile, planning and pilot programs have already begun in some countries, such as Iran and Venezuela.

PROBLEMS ALONG THE WAY

Briefly, that is the scenario I see introducing CBE into virtually all areas of education. But there will be no scarcity of problems along the way.

One difficult problem will be teachers' perception of a threat to their jobs. They will strongly resist the acceptance of educational technology. Although CBE itself will not replace teachers in many courses, it will allow teachers to spend less time on lectures and more time working with individual students. There are many other factors affecting the instructor population, such as growth of open learning. With it comes a shift in relationships, from teacher/pupil toward student/advisor, with an increased ratio of advisors to students. On the other hand, the demand for continuing education is growing and will require more teachers.

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We already see new opportunities opening for teachers, especially women, to upgrade their careers. This is because of CBE's great demand for new courseware. Men are not as entrenched in designing courseware as they are in many other fields, hence the obstacles are fewer for women and the opportunities correspondingly greater.

Also, many positions will open up in the marketing of learning center offerings, and many teachers will find those opportunities attractive. To a considerable extent, the sales force will be made up of teachers who will provide the competence to train other teachers and administrators to use the educational products. In any case, the transition to CBE and use of other advanced technologies will occur gradually; whatever change occurs in the teacher/student ratio, it will not cause abrupt reductions in the number of teachers employed. Rather, the teacher population should remain relatively constant, with teacher productivity and satisfaction improving greatly.

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In addition to resistance because of perceived job threats, there is, and will continue to be, widespread rejection of innovation in education, particularly where advanced educational technology is involved. The reasons are numerous and complex. Extreme conservatism, concerns for maintenance of individual status, dislike for the idea of profit in education, and concerns for quality of results are some of them. In addition to outright rejection, there is institutional inertia. One practical approach to eliminating the rejections and inertia is to offer superior alternatives on a large scale and let the buyer – the student – make the decisions.

THE PRICING PROBLEM

Another problem is pricing. The present method of financing most formal education with tax dollars, contributions, and tuition at lower than cost inhibits improvements in quality, productivity, and availability. It also restricts options that could otherwise be available and maintains the inequality in educational opportunity that results from uneven district-to-district financial resources.

A change to the so-called voucher system now being tested in Alum Rock, California, is a possible answer. (Vouchers or checks are issued to individuals to buy education in schools of their choice.) A voucher system would force all educational institutions to meet the rigors of the marketplace. In other words, in order to survive, educational institutions would have to operate at competitive levels of quality, cost and availability.

There is another set of costs that are really unmeasurable: the costs of forcing students into a mold called a class where the fast learners are held back and the slow learners learn nothing. Individualized learning on the proposed network would impose no such artificial molds. Those who can learn fast will; those who need more time can take more time, but when they have completed the course everyone will have gained equivalent learning. Obviously, we can't measure these costs, but when we see hundreds of thousands of jobless people of high capability who were bored with school and who quit, we know this is a waste of natural resources that we can ill afford.

Yet another social problem that CBE will solve is that of unequal opportunity in education. The contrast today in quality of facilities and instruction between one school district and another is appalling – and, quite literally, unconstitutional. As costs increase, the have-not districts fall even further behind. The CBE network system is the one best hope for finally coming to grips with this frustrating, lingering problem.

POTENTIAL BENEFITS

The potential benefits from a national network of learning centers are becoming visible today, and they are substantial. Considering that these techniques have only begun to be exploited, even more significant results can be expected. It will take many years to develop CAI and computer conferencing to their full potential. Thus flexibility will permit a mix of the new and the old methods.

The CBE system is here and available to reverse the cost trend and to better meet the needs of society with more flexible scheduling, wider alternatives, and curricula more attuned to the pace of change. New knowledge can be brought into education much sooner. This will be important in continuing education, particularly to the practicing professionals in engineering, health care, and other rapidly developing disciplines. Other advantages are on the horizon, too dimly perceived to describe but certainly there.

CONCLUSION

I will conclude by noting that education is entering a new era, one marked by the beginning of a reversal of the past ever-escalating cost trend. At the same time, we can improve quality, expand availability, and offer more options.

This era will come because a marriage is being consummated between business and education, each contributing what it is best equipped to contribute in order to bring advanced technology and the economies of scale to education.

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There are many obstacles to the successful application of technology to education. The rate at which they will be overcome depends upon the rate at which receptive attitudes develop among educators, administrators, and the tax-paying public.

The major obstacles, however, can be recognized as the results of past successes and failures, and *they are surmountable*. The financial resources are available. Enough progress has been made in applying technology to training in business to justify optimism. With the vast market potential in the industrial segment, an educational network now can have the staying power to prove the concept to the rest of education. I believe that this will happen very soon, and I can't think of a more exciting adventure in which to be involved.