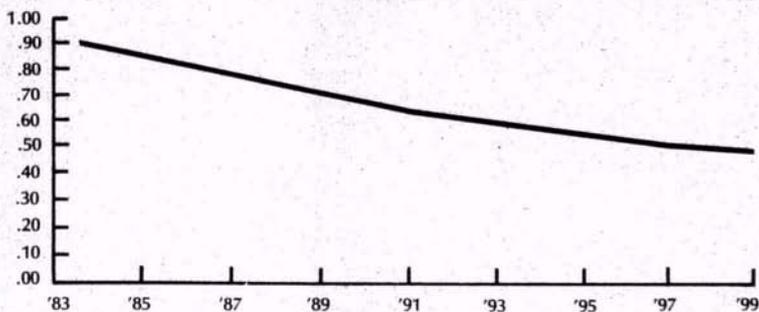


Figure 2. Amounts Available for Instruction Funds in Terms of 1980 Instruction Funds.



schools. However, it creates other problems, some of which I do not have solutions for, such as the displacement of about one out of three traditional teachers.

Another problem has to do with the children and their parents. Working parents would lose 40 percent of the free babysitting services now performed by the schools at no *apparent* cost. Today, working parents with children under school age use daycare centers, and they view that cost as a personal expense that is part of the cost of working. This attitude would have to extend to elementary school age children as well. Certainly, secondary students could use some of the time that CAL would save to provide the additional services needed in daycare centers. In addition, towns would have to organize and administer athletic and recreational activities, as many of them do now.

To be sure, significant change will be required in any case. In a system dominated by CAL, the opportunity to learn will continue; in the case of a system dominated by traditional delivery methods, the opportunity to learn *will* continue.

Unlimited Potential

Computer technology, the most widely applied technology spawned by science in the last 30 years, is not effectively used in education today. After nine years of research in all major aspects of computer-assisted learning, my major conclusions are that:

- The potential for effective use of computers in education is limited only by our attitudes and imaginations.

- The current trend is to adopt microcomputer toys that make tiny extensions of effectiveness to centuries-old educational traditions. *But, computers will not make appreciable improvements*

in education until we use them to deliver mainstream curriculum—for all students—in most subjects.

- There is a serious danger that the opportunities for using CAL effectively will pass us by for another generation—maybe, from the standpoint of public education, forever.

It is an immediate and unavoidable challenge. If we are sufficiently open-

Wrong Reasoning, Right Solution: A Response to Dammeyer

CHRISTOPHER DEDE

Dammeyer's methodological approach and his assumptions about the future both are highly questionable. The concern he expresses about a potential fiscal collapse of the present mode of schooling is, however, well founded. The article thus identifies a real problem, but through faulty reasoning.

Dammeyer uses a forecasting strategy known as "naive extrapolation." A limited set of factors, selected from some brief historical period, is projected forward as if the world were forever condemned to mimic that behavior. This style of "surprise free" prediction was popular among prophets in the late 1950s, but rapidly fell into disfavor as it became apparent that the *most* surprising future of all is a straightforward extrapolation of the present over several decades.

In fact, history demonstrates that "wild cards" and other emerging trends invariably disrupt simple projections

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mind and dedicated, however, we can lead the way to effectively using computers to improve education. This in turn will lead to improving the quality of life—maybe even at the greatly accelerated rate required to enable us to get back on top of our society's worsening problems before they, irreversibly, overwhelm us. □

¹William B. Meher and J. W. Dammeyer, "The Coming Financial Crisis in Education" (Minneapolis: Control Data Corporation, 1976).

²According to data published in *Update* by the Minnesota Department of Education, this is the actual historical behavior during 1972-1978 for Minnesota, which I think is representative of the nation.

³*Update*, published by the Minnesota Department of Education, for school years 1972-73 through 1978-79.

⁴From John W. Dammeyer, *A Newschool* (Sedona, Arizona: Newschool, Inc., 1981). Reprinted by permission of the author and publisher.

⁵For more information, write EMCCO, Inc., 6050 Highway 179, Sedona, AZ 86336.

(witness the fate of Dammeyer's 1976 forecast!). Sophisticated extrapolators now generally use a combination of systems dynamics and cross-impact matrices to model the interaction of historical trends and unexpected events. Such an approach would be a better methodology for deriving a likely scenario for education's fiscal future.

The assumptions that Dammeyer makes in his 1983 prediction also are suspect. He assumes that annual growth in the U.S. GNP will be 2 percent or less for the rest of this century. In fact, a stable or declining GNP in the developed countries for the remainder of the century is likely to bring about a major global depression, with a whole set of challenges for U.S. education that go far beyond the scope of Dammeyer's discussion.

However, recent advances in the information and biological technologies seem capable of creating a "new industrial revolution" in America, with concomitant rising productivity, positive trade balances, and a return to at least moderate affluence. (The National Center for Research in Vocational Education has recently published a paper in which I discuss the likely path this reindustrialization may take and its implications for education). This is not to say that a successful economic transformation is guaranteed—given our present policies, it may be in jeopardy—but

such a future is certainly a very probable alternative.

The fragile nature of the argument Dammeyer makes is further illustrated by the sensitivity of his conclusions to minor changes in assumptions. For example, he states that, at 7.5 percent of GNP by 1999, there will be a 42 percent shortfall in non-instructional costs—if these increase, as he expects, an average of 18 percent per year. However, at 14 percent per year increase, the shortage disappears. His approach is certainly not so sensitive that, with confidence, he can rule out such a possibility.

Overall, then, Dammeyer's specific scenario seems unrealistic. The concerns he sets forward about schooling's short-term financial situation are well-grounded, however. Over four years ago, I forecast that within the next decade schools would be left with half their 1978 revenues. That prediction has so far been very accurate and is likely to remain so for the next few years (since the "new industrial revolution" is not probable before the late 1980s even if we begin behaving intelligently now). My article, "Educational Technology: The Next Ten Years" (most recently reprinted in *Instructional Innovator*, March 1980), presents my own views on how information technologies can be used to ameliorate this intensifying financial crunch. □

Investment in Productivity: A Response to Dammeyer

JOSEPH LIPSON

Dammeyer has performed an important service by making public his analysis of the coming economic shortfall of the public schools. His model and figures are sufficiently reasonable and convincing that anyone concerned with the financial base of a particular school district should take his words to heart and begin the process of arriving at feasible and acceptable solutions in the local setting. I would hope that the intelligent use of technology would be a part of any plan for the future.

The focus on the percentage of the GNP as a controlling factor and the changing ratio of resource allocation between instructional and non-instruc-

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tional costs is a valuable contribution to the discussion of school finances and school effectiveness.

The shortfall figures properly assume for the purpose of highlighting the problem that we will keep doing things in the same way. Since we won't actually experience a shortfall (that is, the system will adjust either by allocating more resources or by reducing expenditures), it is intriguing to speculate how the schools will accommodate to the budget shortage if they do not accept the proposals put forth by Dammeyer.

My principal concern with his article is that Dammeyer assumes that economic pressure is sufficient to create the climate for change. In my experience this is just not so. Large organizations and systems are complex and rigid; they have so many conflicting interests that they usually die rather than adapt to challenge. We need a companion analysis of how one gets from here to there—assuming that we can agree that we should adopt Dammeyer's model.

But good computer-based materials alone will not do the job. We are in danger of overdependence on computers as an economic solution to our school problems. True, there is a potential economic benefit in the use of computers and other information technology, but the cost of running our schools has as much to do with tradition and the cost of supervising our children as with the essential cost of learning.

Computers have the potential to be more than a way to reduce costs. They can allow us to reconsider the curriculum and the knowledge and skill required for the world we are rushing toward. Until the public and the school community value intellectual achievement, computers may have little effect because the effort of learning will not be perceived as essential to competence in the modern world. A recent study of an advanced computer-based system suggests that no matter how powerful the technology, social and motivational factors determine how effectively the technology is used.¹

Dammeyer's proposed solution underestimates the cost of three factors:

1. He underestimates the need for and cost of supervising young children of school age. I do not think that his idea of sending young students off to daycare centers or to work-study assignments is workable. Each has, I suspect, costs about equal to those saved by not having those children in school. One way or another, the custodial cost will have to be paid.

2. He underestimates the need for and the cost of personnel to supervise the computer equipment and the children while they are using it.

3. He underestimates the cost of curriculum research, development, and implementation for the new technologies. J. C. R. Licklider of MIT estimates that it will require \$1 billion per year to prepare the software and courseware the schools need. Herbert Walberg, a noted educational research scientist from the University of Illinois at Chicago Circle estimates much more than that. As I have noted in testimony before Congress, the amount seems huge until one realizes the size of the educational effort (over \$100 billion per year) and one also realizes (or believes) that our multi-trillion dollar economy is dependent on the quality of education.

An implicit and related but unmentioned problem is that some of the public and some leaders no longer think of education as a way to gain the competence to make the economic pie bigger. This group thinks of education as a way of giving people a credential that will let them get a bigger piece of the existing pie. What is missing is a concept of the contribution each needs to make to overall national productivity if the system is to work. Education is much more than a vocational program, but to the extent that education is preparation for work as well as general intellectual development, it should emphasize the acquisition of productivity-related skill by the individual. This orientation would provide an important justification for the investment in education.

As productivity due to computers increases (making people more productive and, therefore, more valuable) it should not be surprising that schooling to prepare for and capitalize on this potential for increased productivity should take a greater fraction of our GNP. However, one expects students to be better prepared as a result of the increased cost. What has been frustrating is that the quality of results has decreased even as the fraction of our GNP devoted to public education has increased. The combination of the computer and the teacher can reverse this trend if society can form a consensus that the systematic acquisition of knowledge and skill is critical.

¹C. V. Bunderson, B. Baillio, J. B. Olsen, with J. I. Lipson and K. M. Fisher, "Instructional Effectiveness of an Intelligent Videodisc in Biology," *Machine-Mediated Learning*, forthcoming.

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