

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

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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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