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ABSTRACT

Intended as a summary report for state leaders, this document outlines current problems in education, particularly science and math education, and suggests ways in which the state educational systems can be changed to provide students with an adequate preparation for knowledge-intensive jobs involving the retrieval, processing, and transmission of information. Skills needed by workers in the growing number of service (as opposed to goods-producing) industries are listed. It is noted that today's students are generally unprepared to work in an information society. Three educational goals related to careers in science and engineering that have been assigned a high priority by the National Science Board are outlined. An identification of educational problem areas mentions the shortage of qualified science and math teachers, the inadequate amount of time for classroom instruction, the outdated nature of science and math curricula, the need for change in instructional approaches, and the lack of public perception of the need for scientific and mathematical literacy among all students. It is recommended that the state legislatures establish comprehensive plans for upgrading education; secure financing to purchase new school computers, software, and science equipment; improve teacher training; revise classroom policies that detract from student achievement; and improve the science and math curricula. A four-item bibliography is included. (ESR)

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17. Information Society Challenges Education

The Issue

The United States has moved from the industrial age to the age of rapid information transmission -- or as it is commonly called, the Information Society.

Due in part to recent advances in electronics and communications, we live in a society in which service industries employ more workers than goods-producing industries and in which an increasing percentage of the workers will be retrieving, processing and transmitting information. The nation's economic emphasis has shifted from labor- and resource-intensive jobs to knowledge-intensive jobs. Consequently, the skills required of many of those entering the labor force have changed as well.

The skills many of our nation's workers need include

- Analysis and evaluation
- "Computer literacy"
- Problem solving
- Critical thinking and decision making

- Communication
- Organization and reference
- Ability to synthesize
- Creativity
- Ability to apply concepts in a wide range of situations.

Not every worker will need such skills, of course. One of the ironies of office computerization is that it will reduce the skills needed for many routine jobs. However, employees who want to rise in an organization to the most strategic and high-paying jobs will need higher order skills to do so.

Many of Today's Students Are Not Prepared

The skills required of some of tomorrow's high-technology workers are those in decline in today's students. Exercises administered by the National Assessment of Educational Progress clearly show that in every learning area examined the percentage of students demonstrating higher-level skills declined. Students have acquired very few skills for examining ideas, and few move on to extended comprehensive and evaluative skills. Another measure of similar skills, the Scholastic Aptitude Test, verifies the declines.

Many students lack the opportunities to become prepared. For example, as many as one-third of U.S. secondary schools do not offer enough mathematics instruction to qualify their graduates for admission to accredited engineering schools. Only one-third of U.S. high schools teach calculus; fewer than one-third offer physics courses taught by qualified physics teachers. Additionally, students who do not plan to go on to college generally stop studying math and science at a very early age.

Education System Has Three Tasks

Three overriding tasks that our education systems must tackle have been outlined by the National Science Board's Commission on Precollege Education in Mathematics Science and Technology. Schools must

1. Generate a larger pool of well prepared and motivated students to pursue professional careers in science and engineering;

2. Widen the range of high-quality educational offerings in mathematics, science and technology at all grade levels, so that more students will be ready to participate in vital technical careers and professions;

3. Raise the general science and technology literacy of all citizens for life, work and full participation in the society of the future.

Problem Areas Identified

Teachers. Nationwide there is a critical shortage of qualified math and science teachers. In 1981 over 80% of the states reported shortages. The end to these shortages is not in sight: the number of student teachers in science and math has decreased markedly over the past decade.

Among those currently teaching math and science, few have had formal training in providing students with an understanding of modern technology.

Few inservice programs exist to certify teachers who are not presently certified to teach math and science.

Most teachers in the primary and middle school grades have not had training in science and math nor have they had courses in science and math teaching methods.

Classrooms. The amount of time available for academic instruction in U.S. schools is less than in other advanced nations. The average U.S. school day is five hours long, compared with six to eight hours in other countries. A portion of this shorter U.S. day is devoted to nonacademic pursuits, further reducing the time available for instruction.

The U.S. school year is shorter than the school year in other countries. Here 180 days is the norm, while in Japan it is 240 days long.

Many U.S. schools simply do not have adequate laboratory equipment. In many cases the available equipment is obsolete, in need of repair or the paraprofessionals needed to set up and maintain it are lacking.

Curricula. Most U.S. science and math curricula were developed 20 years ago and survive today with little or no updating. Methods must be developed to incorporate evolving

technologies and advances in academic disciplines.

In the elementary grades, math courses stress basic computational skills. But while these skills are being taught, students need to be encouraged to reason through problems and determine for themselves the processes required to solve them. Teachers need not wait until students have completely mastered the basic skills before introducing analysis and problem-solving skills.

Upper level high school math and science courses are frequently too abstract and theoretical for non-science/math majors. Yet, in order to function successfully in today's world, these general-curriculum students need more, and more relevant math and science training than is currently available to them.

Instructional approaches. In general, elementary and secondary schools have not taken full advantage of the advances in technology of the last 20 years. While many U.S. schools do have computers, the software is generally inadequate, so the full potential for instruction has not been reached.

While behavioral scientists have discovered a great deal about how people learn, that knowledge has not been applied to the development of science and math curricula, nor to the training of teachers of these subjects.

Many children do not like science and math as these subjects are taught in the classroom; however, they do like the science and technology they see on television or at the local museum. The innovative approaches used by other media need to be examined for possible adaptation to classroom use.

Public perception and priorities. Today's public school math and science policies reflect the nation's perception that these complex subjects are best left to those who want to make them their full time profession. This view fails to take into account the enormous economic, social and cultural changes that have occurred in the past 20 years. While an increasing percentage of today's workforce will be involved with the retrieval, processing and transmission of information, our schools' math and science courses only marginally address the needs of those who will live and work in such a society.

Restructuring State Policies

Establish comprehensive state plans. Changes of the magnitude needed to prepare students for tomorrow's workforce cannot be made in isolation. The involvement of students, parents, teachers, administrators, business leaders, labor leaders and legislators will be necessary. Coordinated, interrelated efforts will be required if we are to upgrade the education our students receive.

Secure financing. As legislators become more acutely aware of the dilemma the education system faces, they will need to consider allocating specific funds for the purchase of computer hardware/software and science equipment, providing tax incentives for private or business donations of hardware/software or science equipment, organizing statewide buying plans to obtain volume discounts, and establishing guidelines for wise spending of technology-related funds.

Improve teacher training. State agencies and policy makers have the power to change teacher education programs, certification requirements and other training efforts to include modern technologies. Also they can identify other resources for program development and inservice training and establish aid programs to encourage qualified students to become teachers of technological subjects.

Revise classroom policies. State agencies and policy makers should consider changing current policies that detract from student achievement. They can lengthen the school day and year, eliminate nonessential programs, provide additional equipment, modify high school and postsecondary entrance and graduation requirements, and stress the teaching and practicing of today's higher-level skills.

Improve curricula. School boards and school administrators should consider adding science and math courses or revising existing courses to equip non-math/science majors to live in a technological society; they should also consider upgrading elementary science programs, beginning the study of specific science disciplines earlier, and using scientists' discoveries concerning how people learn and at what age certain subjects are best introduced.

What To Read

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