Post-Sputnik Education

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Alarm Once Again Over Inadequacies

The Soviet Union's launching of Sputnik 25 years ago, on Oct. 4, 1957, sent the American education establishment into a tailspin. At least since the early 1940s the trend in education had been toward the social development of children rather than an emphasis on hard academic subject matter. At the same time, however, there had been a growing concern about whether math and science education was adequate and whether enough students were prepared and interested in seeking careers that would help advance American technology.

Russia's dramatic exploit in space[1] highlighted the costs of neglecting rigorous academic training, particularly in math and science, and galvanized this nation to action. President Eisenhower stressed the importance of education to national security, and American leaders rushed to bolster the nation's science, math and foreign language instruction, funding university research and development projects, providing scholarships and otherwise encouraging young people to enter technological careers. This was done largely through the National Defense Education Act of 1958, which was in many ways the forerunner of general federal aid to education.

Twenty-five years later educators, scientists, industrialists and other concerned citizens are again declaring that American children are not being adequately educated, which they see as posing a threat to economic growth and national security. Last spring President Reagan told a meeting sponsored by the National Academy of Sciences that problems in math and science teaching are “serious enough to compromise the nation's future ability to develop and advance our traditional industrial base to compete in international marketplaces.“[2] Dr. Harry Lustig, dean of science at City College of New York, said, “I see us becoming industrially a second-rate power.“

Declining student competency, reduced requirements for graduation, a shortage of qualified teachers and an inadequate supply of instructional materials are factors cited as evidence of the poor state of math and science instruction, at a time when America's competitors as well as allies are placing greater emphasis on these subjects. Experts say a scarcity of trained personnel in various scientific fields is cause for alarm. They add that the pool from which such personnel can be drawn is diminishing, even as the need is increasing. At the same time, by luring math and science teachers into industry with high salaries, “we are consuming our seed corn,” said Denis P. Doyle, director of education policy studies at the American Enterprise Institute in Washington, D.C.[3]

An overall decline in the public's scientific literacy is also perceived. “Even now too few Americans have the science or mathematics grounding to keep America in the forefront technologically and economically, and it appears that our future citizenry as a whole will be even *less* well prepared to understand and support scientific development,” say the authors of a recent report published by the American Association for the Advancement of Science (AAAS).[4]

These concerns are surfacing at a time when the federal government is slashing funding for elementary and secondary education, including science education, and individual states, under their own budgetary strains, are reducing their support as well. Many people advocate a “Sputnik-style” federal investment, but the Reagan administration opposes such an effort. “We disagree with those who say that the federal government should be ultimately responsible for this problem,” presidential policy adviser Edwin L. Harper told the National Academy of Sciences meeting. Businesses, the states and local school districts must play their part, he added. Wherever the solution lies, educational historian Diane Ravitch told Editorial Research Reports, “now it's almost as though we're waiting for a Sputnik to focus everyone's attention on the problem.“

Evidence of Crisis in Math and Science

One of the first signs of trouble educators point to is the steady decline of achievement test scores in math and science over the last 15 years. The most drastic drops have occurred in the higher grades. The decline is taking place mostly among youngsters not planning careers in science or engineering. Education analysts say that means the most advanced students are learning as much as they ever did but the majority of students are learning less. The Advisory Panel on the SAT Score Decline has explained that the downward trend between 1963 and 1970 could be accounted for by changes in the test-taking group; during that period it included more college-bound minority and low-income students than before.[5] But since 1970 the composition of test-takers has remained fairly stable, and scores have dropped even more sharply.

In trying to explain the decline the panel concluded that aside from the usual villains of high divorce rates, television, Vietnam, Watergate and drugs, lower academic standards may also have played a large part. “Absenteeism formerly considered intolerable is now condoned,” said the AAAS report. “An ‘A’ or ‘B’ means a good deal less than it used to. Promotion from one grade to another has become almost automatic. Homework has apparently been cut about in half.” According to a recent study by the National Research Council, only a third of the nation's high schools offer more than one year of math or science and at least half of all high-school seniors graduated without a single year of physics or chemistry.[6] A sample survey found that over 56 percent of the high schools require no math courses or only one for graduation.[7]

With requirements for graduation reduced, children are evidently passing through the system without acquiring basic skills. This has led to the so-called back-to-basics movement, which some observers say often has had the effect of reducing learning to its lowest level at the expense of a more rounded education. The National Congress of Parents and Teachers noted: “Though emphasis on acquiring basic skills is at the heart of the education process, there is a distinct possibility of basics becoming *the* curriculum rather than just *part* of the curriculum. Another problem, with an overemphasis on basics, is a tendency to teach children only those things for which they will be tested, a tendency that leads to mediocrity.“[8]

According to the authors of the 1980 National Science Foundation and Department of Education study, “Science and Engineering Education for the 1980s and Beyond,” the focus on basics is affecting science teaching, particularly in elementary schools. Since science is not considered basic at this level, the authors say, what little attention has been paid it is diminishing.

In addition to test scores, enrollments in upper-level science and math classes have also declined over the years. In 1960–61, for example, 59 percent of all students in grades 9–12 were enrolled in at least one science class. By 1976–77 only 48 percent were. The National Science Foundation concluded that about one-sixth of all high-school graduates have taken junior- and senior-level science and math courses. Half of the graduates have taken no science or math beyond the 10th grade and only half of those entering college have had any significant exposure to physical science or advanced math beyond the 10th grade.

It has been suggested that lower enrollments and declining achievements may be related to the fact that many colleges and universities have reduced their standards for admission to attract more students. The Carnegie Council on Policy Studies in Higher Education concluded that reduced college entrance and retention requirements have harmed high-school academic standards.

Industry's Lure to Qualified Teachers

A related cause for alarm is a shortage of qualified teachers, particularly in physics, chemistry and math. According to the National Science Teachers Association (NSTA), between 1971 and 1980 there was a 77 percent decline in the number of teachers qualified to teach math and a 65 percent decline in the number qualified to teach science in secondary schools. The percentage of those trained to teach math and science who actually do so has also declined. The combined effect, says NSTA, is a 68 percent reduction in newly employed science teachers and an 80 percent reduction of math teachers since 1971.

Another survey by the same association found that among newly employed science and math teachers, about half were unqualified to teach those subjects. They had been employed on an emergency basis because no qualified teachers could be found. Shortages were especially apparent in states where high technology industries are numerous, providing abundant job opportunities to persons trained in math and science. Computerization in industry has been a boon, especially to persons trained in math. Until the age of computers, their job market was relatively small. Experts have estimated that schools are losing five times as many science and math teachers to industry as to retirement.

Teacher shortages in math and science not only result from better-paying work in industry but also, evidently, from disillusionment with teaching. The conditions under which teachers work, including low pay and a general indifference to their status, have deteriorated because of rising costs, taxpayer resistance to higher teaching salaries, and lack of student motivation. The financial factors along with declining enrollments have particularly affected math and science education because they have led to less spending for equipment and facilities needed to teach those subjects.

One form of teacher support that grew out of post-Sputnik federal involvement was summer institutes funded by the National Science Foundation. But their funding started declining in 1968, all but disappeared in 1975 and was eliminated altogether this year. Research on the summer institute program concluded that it did have a significant impact on secondary school science and math education but that few of the least qualified teachers participated.[9]

How U.S. Compares with Other Nations

In “Science and Engineering Education for the 1980s and Beyond,” the authors wrote: “The declining emphasis on science and mathematics in our school systems is in marked contrast to other industrialized countries. Japan, Germany, and the Soviet Union all provide rigorous training in science and mathematics for nearly all their students at the pre-college levels. We fear a loss of our competitive edge.” In these countries, unlike the United States, national policy promotes comprehensive science and math education for everyone, not just those planning to specialize.

In the U.S.S.R. and Japan, for example, a large number of people in both government and industry have engineering degrees. In Japan, more engineering degrees have been granted in recent years than in the United States, which has nearly twice as many people. About 20 percent of all baccalaureate degrees and 40 percent of all master's degrees are in engineering, compared to about 5 percent at both levels in the United States. Japanese educators explain that in Japan engineering degrees are seen as a ticket to success in much the same way M.B.A.—master of business administration—degrees have been regarded here.

Unlike the United States, secondary education in Japan is weighted heavily toward science and math. A national guideline calls for 25 percent of class time in grades seven through nine to be spent in those studies. In grades nine through twelve nearly all college-bound students take three natural science courses and four math courses. Only 34 percent of the approximately three million U.S. high-school students complete three years of math by the time they graduate, according to Paul DeHart Hurd, professor emeritus at Stanford University.[10]

Science instruction begins early for the college-bound in Germany. By the time the German student reaches the fifth grade, he or she is spending two to three hours a week on each of four science-math courses—biology, chemistry, geometry and physics. In the United States, out of a 25-hour school week, elementary students receive about one hour of instruction in science and four in math. Most don't study algebra until the ninth grade; in Germany it is introduced in the seventh grade.

Science and math reportedly receive more attention in the Soviet Union than in any other country. Math is introduced in the first grade, biology in the fifth, physics in the sixth and chemistry in the seventh. Algebra and geometry are taught in the sixth and seventh grades, and trigonometry in grades eight through 10. Only 5 percent of the high-school students in California, for example, take trigonometry at all, according to Michael W. Kirst, an education professor at Stanford University.

About 500,000 Americans take calculus in the 12th grade or first year of college, while it is part of the Soviet high-school curriculum for more than five million students. In a recently prepared survey of curriculum materials in the Soviet Union, the author concluded that secondary-level Soviet math and science courses are comparable to introductory college courses in the United States. His survey also indicated that Russian science and math teachers were more numerous and better prepared than their American counterparts.[11]

educationtrendssince1957" class="subtitle">Education Trends since 1957

Soviet Exploit: Education Fund Catalyst

Sputnik came at a time when if it hadn't happened it would have had to have been invented,” said Diane Ravitch in a recent interview. “It gave a push to a lot of nascent trends.” One of these trends was increased federal support for science and engineering education. At the end of World War II, President Roosevelt asked Vannevar Bush, the director of the Office of Scientific Research and Development, to examine science research in the United States. One aspect of Bush's inquiry was the adequacy of education in discovering and developing scientific talent. Bush's report, “Science—The Endless Frontier,” for the first time established this development as a federal responsibility.[12]

The National Science Foundation, established in 1950, was the government's primary means for doing this, but it concentrated on graduate students who had already chosen science and engineering careers. In the mid-1950s, however, it began paying attention to elementary and secondary education through teacher training institutes and curriculum development. After Sputnik was launched the foundation's budget for science education increased substantially; Americans who examined the Soviet education system for clues to Russian superiority in space discovered the Soviet emphasis on science, mathematics and foreign languages.[13] Congress than passed the National Defense Education Act (NDEA) in 1958 to support the study of these subjects in American schools.

The act accounted for a major increase in federal spending on elementary and secondary education.[14] The stated aim was to "meet the present education emergency" by providing federal financial assistance to individuals and states "in order to insure trained manpower of sufficient quality and quantity to meet the national defense needs." One of its provisions was for new science education programs in the U.S. Office (now Department) of Education. The potential overlap between the Office of Education and the National Science Foundation, with its new authority to support science, engineering and math education at all levels, was resolved through the understanding that the Office of Education would operate mainly through the states and local school systems and the NSF would operate through colleges and universities, individual scientists and scientific societies.

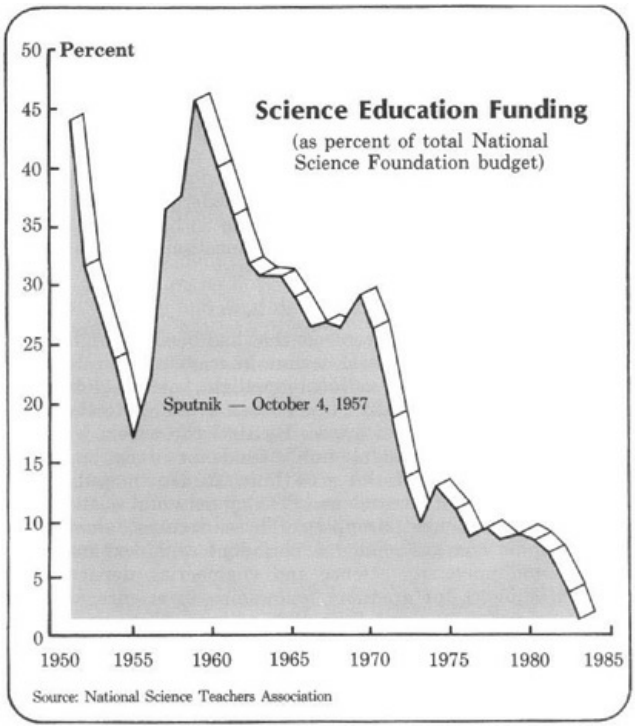
Between 1959 and 1962 three government reports on science and engineering education recommended an expanded federal role in those areas.[15] NSF funding, however, has been declining since the late 1950s. and, according to Sarah E. Klein, president of the National Science Teachers Association, "the present cluster of national problems in secondary school science and math education can in large part be attributed to the National Science Foundation's negligence of …their [sic] congressionally mandated mission."[16]

Focus on Gifted; Increased Federal Aid

Changes in the teaching of physics, chemistry, biology and math over the past 25 years have largely resulted from NSF curriculum development efforts. When these were implemented in the late 1950s and early 1960s, students were encouraged to discover the sciences by experimenting rather than by memorizing formulas and theorems. Mathematicians began to question the traditional curriculum and to search for better ways of teaching math. From their efforts came the "new" math. It sought to broaden the understanding of mathematics among students by introducing them to the fundamental principles and theories. "Conceptual insight" became a favorite phrase. Students were introduced to set theory, the concepts of union and intersection, and the associative, distributive and commutative laws. They were also taught how to compute in base systems other than base 10.

These efforts were largely directed toward gifted children, as the "pursuit of excellence" became a rallying cry for American educators during this period. A national conference on the academically talented secondary school student, sponsored by the National Education Association, met in Washington in February 1958 and, under the chairmanship of James B. Conant, president emeritus of Harvard, drew up a number of recommendations for activating gifted-child programs in the public schools. During this period the number of research projects on the nature of giftedness increased significantly. "Probably 20 times as much material was published on this subject in the decade 1950–1960 as in any previous 10-year period," Gertrude H. Hildreth wrote in *Introduction to the Gifted* (1966).

Changes in social studies education also began to take place. In the mid-1950s history and geography dominated social studies but by the early 1960s a much-debated NSF-funded curriculum called "Man; A Course of Study" had been introduced, designed for children in the fifth and sixth grades. Writing in the April 1979 issue of *Educational Leadership*, education Professor Gerald Ponder said, "The social studies curriculum was to become organized by the concepts and principles that formed the structure of the scientific disciplines instead of the chronological organization of history. Rather than memorizing names and dates, students were to inquire into causality and develop their own generalizations from primary source material, from direct observation of social events and processes, and from games and simulations,"[17]



In the meantime, government aid increased rapidly during the 1960s. For the first time, Congress approved federal scholarships for needy undergraduates under the Higher Education Act of 1965. The Elementary and Secondary Education Act (ESEA), passed the same year, provided financial assistance for education programs such as the preschool "Head Start" project, aimed at increasing the opportunities of disadvantaged children in inner cities and rural areas. Federal funds for education almost doubled in 1957–64 and more than doubled in 1965–1966 as a result of the ESEA; it raised the federal contribution to education from $1.1 billion in 1963–64 to $3 billion in 1967–68, increasing the federal share of public education expenses from 5 percent to 9 percent.

Switch from 'Open Education' to Basics

By the late 1960s the problems that had been highlighted by Sputnik—that of a general decline in academic standards—had receded from the national spotlight, overshadowed by concerns about the quality of education available to the poor, minorities and the handicapped. By 1968 the war in Vietnam had begun to erode available public funds for education, which started to lag behind the growth in student population.[18] Federal support for research and development and science education also continued dropping. These declines, along with demographic changes, ended a period of rapid expansion of college and university science and engineering departments. Federal support for graduate fellowships in science and engineering also went down from 1968 onward. NSF support for teacher training institutes and curriculum development dropped off in the early 1970s and by mid-decade had virtually disappeared.

The decline in federal support for science education coincided with a shift in emphasis in many of the nation's schools, which were greatly influenced by the country's anti-establishment mood in the late 1960s. Ironically, the emphasis on learning through discovery and inquiry that had gained popularity through the NSF's curriculum development efforts had by this time begun to feed into the building of the open education movement. And, according to Diane Ravitch, it had gained enough momentum by 1967 to create an academic laxity similar to the one many educators complained about in the 1950s.

In response to student demand for greater flexibility and "relevance," colleges began lowering their entrance requirements and high schools began abolishing certain course requirements. "As requirements fell," Ravitch wrote in *The New Republic*, "the notion of a common curriculum was undermined. To maintain student interest, courses in traditional subjects were fragmented into electives and mini-courses …and requirements in the 'hard' subjects like mathematics, science and foreign language were eased or eliminated."[19]

The brightest and most motivated students continued taking advanced college-preparatory courses but others found they could easily avoid the most challenging courses. Ravitch attributes lower teacher expectations of students to uncertainty about what students should study, which undermined the teachers' sense of purpose and authority. This situation, added to the general student unrest and societal permissiveness in the 1960s, made it increasingly difficult for them to impose demands. Truancy and discipline problems increased and homework and essays fell into disfavor.

In the mid-1970s, however, educators snapped to attention when they noticed declines in SAT scores. The back-to-basics movement, with its emphasis on fundamentals and traditional teaching methods, took hold when educators realized that the innovations of the late 1960s and early 1970s were not yielding desired results. An offshoot of the trend back to basics was the adoption by many states of standardized, minimal competency tests. Now 38 states use competency testing, which is a requirement for high school graduation in 17 of them.[20]

In the late 1970s came a new surge of interest in private secondary schools. Parents became disenchanted with public schools because of their apparent failure to educate children both intellectually and morally. That has been a large factor in the recent support by many, including the Reagan administration, of tuition tax credits for private schools.[21] The Republican Party's 1980 platform championed tuition tax credits as "a matter of fairness, especially for low-income families, most of whom would be free for the first time to choose for their children those schools which best correspond to their own cultural and moral values." Opponents of the tuition tax credits argue, however, they will undermine the already beleaguered public school system. Two proposed tax credit programs have failed in Congress since 1978, and recently a third was introduced by Senate Finance Committee Chairman Robert Dole, R-Kan., on behalf of the administration. Although the outlook for any tax credit proposal is doubtful this year, the issue is expected to remain alive throughout this decade.

Evaluation of Sputnik-Inspired Changes

In 1978 the National Science Foundation completed three studies on local, state and national efforts to reform elementary and secondary school curricula since Sputnik to find out what had happened in science, math and social studies education.[22] The conditions they found in 1978 have not significantly changed since then, according to most educators. Apparently math instruction has changed very little since 1955. The new math that grew out of NSF-supported efforts was widely used for a short time but fell quickly into disfavor because it was baffling to most students, teachers and parents, and failed to get results. Over a third of the principals and about a fourth of the supervisors and teachers surveyed by the NSF said the new math had been a waste of time and money.

Twenty-four years ago James Killian, President Eisenhower's first special assistant for science and technology, said: "We must modernize and invigorate science education, strive for a higher degree of scientific literacy among the rank and file of Americans, and correct the erroneous view that science is only vocational, materialistic and anti-humanistic."[23] However, according to NSF's studies, there is little evidence that these goals for science education have ever been translated into any long-lasting curriculum or classroom practice.

In a summary of NSF's findings that appeared in the March 1979 issue of *Educational Leadership*, educators Robert E. Yager and Ronald Stodghill wrote, "The science curriculum exists as the facts and concepts that are traditionally packaged as textbooks.…Little real curriculum planning or school articulation of science materials has occurred."[24] The inquiry and discovery method of teaching math and science that was promoted heavily after Sputnik is apparently not used much, nor are the materials designed to promote those techniques.

The impact of NSF-supported national science programs, which de-emphasized practical applied science and emphasized basic concepts and processes, has been negligible. About a third of the schools surveyed use or have used one of the several NSF-developed elementary programs, and about the same number of high schools have used NSF-funded chemistry and physics courses. But teachers who have tried the NSF curricula seem to be slowly returning to the old courses. Use of these programs had increased until 1970 and then started declining, mostly because the material was too difficult and abstract for most students.

Philip Jackson, professor of education and behavioral science at the University of Chicago, believes that the climate of the country in the late 1960s was a crucial factor in the decline in use of these Sputnik-inspired programs. Science and technology were seen as dehumanizing forces during this period of Vietnam War protest, denial of traditional values and interest in alternative lifestyles. According to Jackson, the most significant impact of NSF-funded science courses seems to have been that much of their content and methods have been absorbed into commercially published textbooks.

The expensive and ambitious social studies program that emerged after Sputnik called “Man: A Course of Study” is used in less than 5 percent of the schools today, Diane Ravitch told Editorial Research Reports. She explained: “It was basically driven out of the schools because it was so controversial. It used anthropological concepts that a lot of people found extremely hard to understand, and a lot of parents found it objection-able and subversive.” The National Science Foundation has concluded that little has changed in social studies since the 1950s. In high schools, history and geography rather than social science are still the dominant subjects. In elementary schools, social studies serve mostly as an opportunity to teach reading and writing. A Colorado teacher reported, “We do math and reading in the morning when the kids are fresh. We do science and social studies in the afternoon, if there's a chance.“[25]

Many educators have concluded that although the NSF-funded curricula may have been excellent in themselves, there was a failure in translating them so they could be used by most teachers. It was the better teachers who attended teacher-training institutes; the ones who needed help most did not participate. However, educators say that rather than a failure in training teachers, the curricula reflected more of a failure in understanding how children learn.

Preliminary results of a 1982 NSF study indicate that although the new curricula are not widely used now, they were more successful than most people realized.[26] An analysis was made of 105 studies in the 1960s and 1970s involving 45,000 students. The researchers compared students enrolled in traditional curricula with those enrolled in NSF curricula. On every measure, including achievement, attitude and process skills, the latter group of students scored 14 percent higher overall. According to National Science Teachers Association President Sarah Klein, what is most significant is that students from low socio-economic groups scored 24 percent higher using the new curricula.

debateoverresponsibility" class="subtitle">Debate Over Responsibility

Quest for Renewal Federal Commitment

Few Would contest the prevailing belief that scientific illiteracy resulting from problems in math and science education hurts the nation's quest for supremacy in high technology. Where the solutions lie, however, is the subject of debate. Educators typically believe that the federal government has a major responsibility in funding science education. But the Reagan administration is reducing the federal financing of education at all levels.

Of the $20.4 million appropriated for the National Science Foundation's 1982 science education activities, $15 million was for graduate fellowships.[27] The National Science Teachers Association points out that since graduate fellowship support is basically support for graduate research, the National Science Foundation has essentially eliminated its science education activities. “The administration has successfully forced NSF to abandon one of its missions,” Sarah Klein told a House Appropriations Committee hearing on the 1983 budget.

While the NSTA concedes that the government alone cannot solve the problem of low salaries for science and math teachers, for example, it says the government can help reduce the severity of teacher shortages. It proposes NSF scholarships for math and science teachers, NSF-supported programs of publicity on the need for teachers, NSF-supported courses and workshops for marginally qualified teachers and science consultants, and partial funding of microcomputers in schools.

What the NSF has done is establish a Commission on Pre-college Education in Mathematics, Science and Technology, in the words of its charter, to “define a national agenda for improving math and science education in this country.” The commission, the charter adds, “will develop an action plan that will include a definition of appropriate roles and responsibilities of federal, state and local governments, professional and scientific societies, and the private sector in addressing this problem of national dimension.“

The National Education Assocition is also in favor of strong federal support. A bill it drafted, called the American Defense Education Act and introduced in Congress in June, is a modern version of the National Defense Education Act. NEA's bill would have the federal government provide incentives to local school districts to improve instruction in math, science, communication skills, foreign languages and new technologies. A unique feature of the bill is that although its provisions would be administered under the Department of Education, the Department of Defense would project personnel training needs of the armed forces.

“The crisis is upon us,” said Denis Doyle of the American Enterprise Institute, “and it is being compounded by the administration's decision to further reduce higher education spending, *without* [his emphasis] proposing a workable alternative. This is precisely the time when increases in human capital investment are most needed. It takes 20 years to train the next generation of engineers, scientists and linguists.“[28]

Doyle supports a kind of GI Bill of Rights in reverse, first proposed by Boston University President John Silber. Instead of college aid to individuals for past service—as in the case of military veterans—funds would be made available prospectively. Students who became doctors, nurses and teachers, for example, would have their college-aid debts canceled by working in those professions. Students who received aid but pursued other careers would repay their aid funds through an income tax surcharge. There are existing but limited programs for medical and nursing students.

Potential Roles for States and Industry

While the federal government has stated its concern about science and math education, it is looking to industry, the states and local school districts for their help. Secretary of Education Terrel H. Bell has called on states and local schools to set up task forces to “develop a means of parting with the single salary schedule to help stem the erosion, in fact, the bleeding off, of mathematics and science teachers into other disciplines.“[29] The alternative to a single salary schedule—that is, all teachers being paid equally—would be payment by specialty, whereby a math teacher, for example, could earn more than an art teacher. Although some schools are considering differential salary scales, the American Federation of Teachers opposes such a move, claiming that pay differences would be too small to keep significant numbers of math and science teachers in schools but large enough to cause friction with other teachers.[30]

To encourage industry to help out, several members of Congress have introduced bills focusing on teacher and equipment shortages. Rep. Fortney H. "Pete" Stark, D-Calif., would increase tax deductions available to companies that donate computers to elementary and secondary schools. Currently, full deductions for such scientific equipment are allowed only if it is given to college and universities. If Stark's bill passes, the chairman and co-founder of Apple Computer Inc., Steven A. Jobbs, said he would donate a new computer to every school in the country. A bill introduced by Sen. Lloyd Bentsen, D-Texas, offers tax deductions to companies that donate equipment to vocational schools.

Even without generous tax advantages some companies have already begun to help schools out, acknowledging that industry is partially responsible for the current teacher shortage, having lured away many present and future instructors with generous pay offers. The Exxon Foundation, for example, has donated $15 million to help engineering schools obtain and keep faculty members, and Motorola gave $1.2 million to Arizona State University's engineering program.

Sen. John Glenn, D-Ohio, and Rep. Dave McCurdy, D-Okla., each introduced two bills supported by the National Association of Secondary School Principals. One would give tax credits to firms that hire public school science and math teachers during the summer—to augment their paychecks so they could remain in teaching—or let their employees who are former teachers return to the classroom to teach 10 hours a week. The other bill would provide 7 percent loans to science and math teachers. A quarter of the debt would be written off for each year the loan recipient teaches.

The idea of enticing students to teach math and science by awarding them forgivable loans is catching on in the states as well. College students in Kentucky this fall will be eligible for $2,500-a-year loans they will not have to repay if they teach science or math in elementary or secondary schools. A new program in Alabama will award loans covering tuition, room, board and books. Students will not have to repay these loans if they become high-school teachers of math, chemistry, physics, biology or general science.

Schools Raising Academic Requirements

Aside from adopting minimum competency tests for high school students, increasing numbers of states have begun raising their standards for incoming teachers. Recent changes in teacher licensing requirements have been adopted in Texas, Delaware, New Mexico, New Jersey, Maryland and Connecticut. Stiffer curriculum requirements also seem to be making a comeback. Texas recently eliminated extraneous courses from its requirements. California is proposing that every student have three years of math and two of science in order to graduate. In Florida a similar proposal would require four years of math and four of science.

While some experts are rethinking graduation requirements, particularly in math and science, others are considering more basic changes in the structure of the American school system. In 1959 James B. Conant's influential book *The American High School Today* attacked the quality of education for academically gifted students and spurred the creation of large centralized high schools offering both academic and vocational instruction.[31] A new study of secondary education by the Carnegie Foundation for the Advancement of Teaching, which will be released next year, will conclude that students would be better served by smaller specialized schools that could address their needs more directly.

Whatever the answers are to improving children's education, transformations will not occur overnight. Money, and who should provide how much, is only part of the problem. Diane Ravitch wrote, "The problem is that we lack consensus about whether there should be a common curriculum, whether there are knowledge and skills that everyone should have. If we believed that it was important to have a highly literate public, to have a public capable of understanding history and politics and economics, to have citizens who are knowledgeable about science and technology, to have a society in which the powers of verbal communication are developed systematically and intentionally, then we would know what we wanted of our schools. Until we do, we get the schools we deserve, which accurately reflect our own confusion about the value of education."[32] Growing alarm about scientific and technological illiteracy, which experts see as seriously endangering our national prospects, could—as Sputnik did in 1957—clarify this confusion and serve as a catalyst for an educational overhaul.

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Cover drawing by Staff Artist Robert Redding; p. 663 graph by Staff Artist Cheryl Rowe; p. 667 drawing by George Rebh.

Footnotes

[1] Sputnik I was the first space satellite to be put into orbit around the Earth. This small (184-pound) unmanned sphere circled the globe every 96.2 minutes. A month later, on Nov. 3, a bigger Sputnik II (1,120 pounds) was sent aloft carrying a dog into orbit. The United States ultimately captured the greatest glory in the space race by sending men to the moon for the first time in 1969.

[2] Written statement presented to the meeting, the national Convocation on Preschool Education in Mathematics and Science. It was held in Washington, D.C., May 12, 1982.

[3] Writing in *The Washington Post*, March 10, 1982.

[4] “Education in the Sciences: A Developing Crisis,” 1982, p. 3.

[5] College Entrance Examination Board. “On Further Examination,” report of the Advisory Panel on the Scholastic Aptitude Test, 1977.

[6] Cited by Otto Sturzenegger in “We'd Better Do Something About Science Education,” *Industry Week*, July 26, 1982.

[7] Catherine P. Ailes and Francis W. Rushing, *The Science Race: Training and Utilization of Scientists and Engineers, US and USSR*, Crane Russak, 1982.

[8] Quoted in “Science and Engineering Education for the 1980s and Beyond,” National Science Foundation and the Department of Education, 1980, p. 48.

[9] Stanley Helgeson, “Impact of the National Science Foundation Summer Institute Program,” The Ohio State University, 1974.

[10] Writing in *The Washington Post*, May 16, 1982.

[11] Nicholas DeWitt, “Current Status and Determinants of Science Education in Soviet Secondary Schools,” prepared for the National Academy of Sciences, 1980.

[12] Vannevar Bush, “Science—The Endless Frontier,” first issued in 1945, reprinted by the National Science Foundation, 1980.

[13] America also encountered great difficulties in its attempt to improve student proficiency in foreign languages, See “Foreign Languages: Tongue-Tied Americans,” *E.R.R.*, 1980 Vol. II, pp. 677–696. The post-Sputnik era is reviewed in pp. 687–689.

[14] This funding rose from $128.3 billion in fiscal year 1957 to $224.9 billion in 1960.

[15] “Education for the Age of Science,” 1959; “Scientific Progress, The Universities and the Federal Government,” 1960; and “Meeting Manpower Needs in Science and Technology,” 1962. All reports were prepared by the President's Science Advisory Committee.

[16] Testimony before the Subcommittee on HUD-Independent Agencies of the House Appropriations Committee, May 18, 1982.

[17] Gerald Ponder, “The More Things Change …; The Status of Social Studies,” *Educational Leadership*, April 1979, p. 515. The magazine is published by the Association for Education and Curriculum Development, Alexandria, Va.

[18] See “Debating National Education Policy: The Question of Standards,” American Enterprise Institute for Public Policy Research. 1981.

[19] Diane Ravitch, “The Schools We Deserve,” *The New Republic*, April 18, 1981, p. 26.

[20] See “Education's Return to Basics,” *E.R.R.*, 1975 Vol. II, pp. 667–684, and “Competency Tests,” *E.R.R.*, 1978 Vol. II, pp. 603–620.

[21] See “Tuition Tax Credits,” *E.R.R.*, 1981 Vol. II, pp. 595–612, and “Private School Resurgence,” *E.R.R.*, 1979 Vol. I, pp. 285–304.

[22] See S. L. Helgeson and others, “The Status of Pre-College Science, Mathematics, and Social Studies Educational Practices in U.S. Schools: An Overview and Summaries of Three Studies,” U.S. Government Printing Office, 1978.

[23] Quoted by Oto Sturzenegger, *op. cit.*, p. 13.

[24] Robert E. Yager and Ronald Stodghill, “School Science in the Age of Science,” *Educational Leadership*, March 1979, pp. 439, 440. Yager is head of the Science Education Center at the University of Iowa; Stodghill is associate superintendent of instructional support services for St. Louis public schools.

[25] Quoted by Gerald Ponder, *op. cit.*, p. 516.

[26] Ronald Anderson and others, "Preliminary Results of Project NSF SED 80–12310," National Science Foundation, 1982.

[27] Science education funds were cut from $77 million in 1980 to a proposed $15 million for 1983.

[28] Writing in *The Washington Post*, March 10, 1982.

[29] Address to National Convocation on Preschool Education in Mathematics and Science.

[30] AFT proposes that all salaries be raised uniformly and that schools test teachers in glutted subject areas, such as history and the arts, for math or science aptitude. If the teachers are willing and able, they could be retrained rather than laid off.

[31] James B. Conant, *The American High School Today* (1967)

[32] Diane Ravitch, *op. cit.* p. 27.

Special Focus

Declining Math Test Scores

School Year	SAT Averages
1966–67	495
1967–68	494
1968–69	491
1969–70	488
1970–71	487
1971–72	482
1972–73	481
1973–74	478
1974–75	473
1975–76	470
1976–77	471
1977–78	469
1978–79	466
1979–80	466
1980–81	466

Scholastic Aptitude Test scale ranges from 200 to 800.

Source: Educational Testing Service, Princeton. N.J.